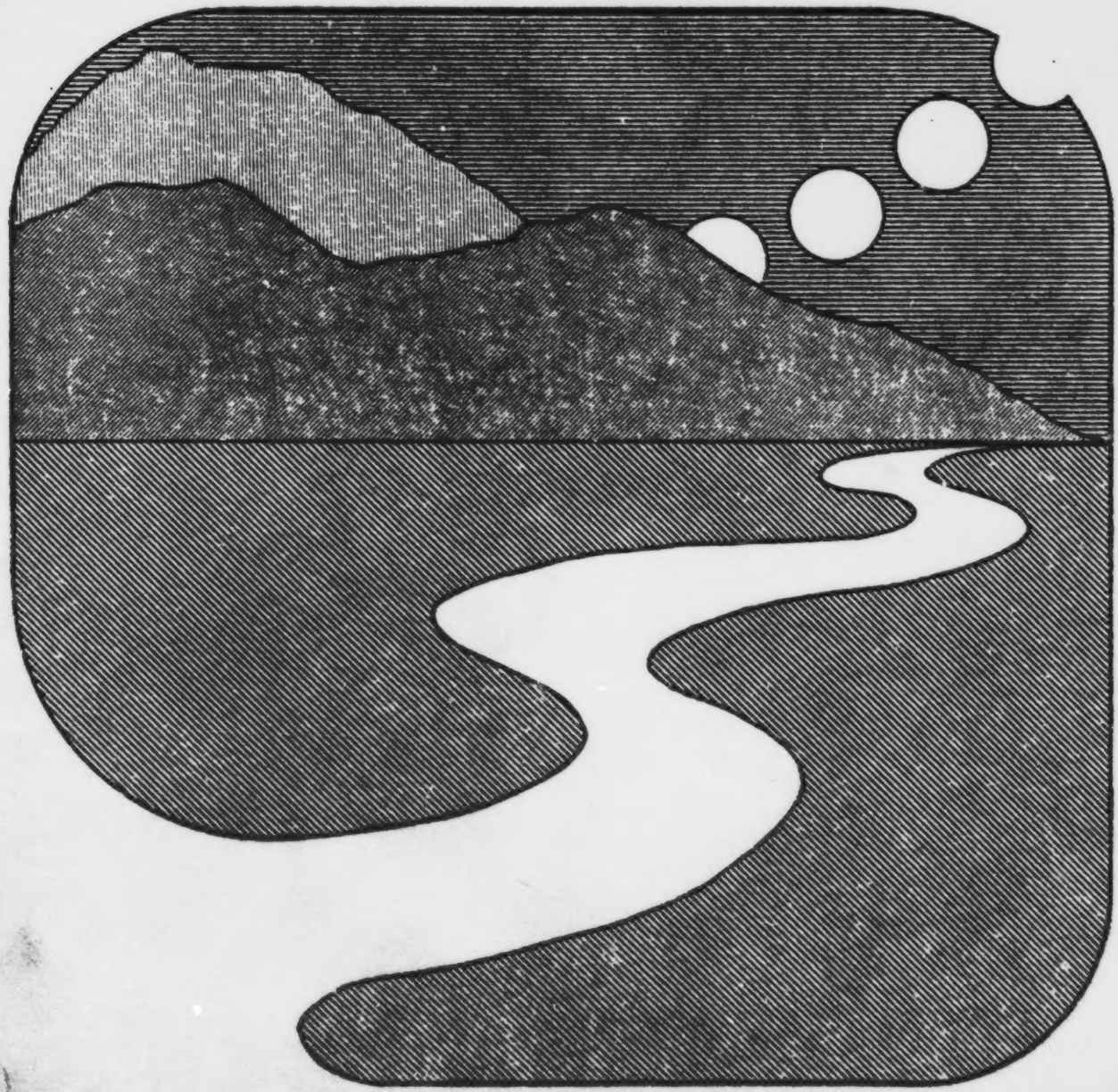
Stream Habitat Inventory and Evaluation for Two Study Areas in the Yukon River Basin

Project Report: Fisheries No. 3

YUKON RIVER BASIN STUDY

This project was completed for the Yukon River Basin Study, an intergovernmental study funded by the governments of Canada, Yukon and British Columbia.

Yukon
Department of Renewable Resources



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Stream Habitat Inventory and Evaluation for Two Study Areas within the Yukon River Basin

by:

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November, 1983

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This report was funded by the Yukon River Basin Committee under the terms of "An Agreement Respecting Studies and Planning of Water Resources in the Yukon River Basin" between Canada, British Columbia, and Yukon. The views, conclusions, and recommendations are those of the author and not necessarily those of the Yukon River Basin Committee or the Governments of Canada, British Columbia and Yukon.

TERMS OF REFERENCE

This study is Project 34 of the Yukon River Basin Study. The terms of reference, as outlined in the Project Description, are as follows:

PROJECT DESCRIPTION:

Application and refinement of stream inventory system necessary to classify potential placer mining streams according to habitat categories and associated fish capabilities. The habitat evaluation/assessment would be applied to approximately 100 streams with placer mining potential and their associated tributaries. The study areas are in the Stewart and Atlin watersheds.

The anticipated products from this program would include:

1. Working model for habitat evaluation/assessment;
2. List of streams with a designated habitat rating;
3. Maps of the streams showing fish species distribution, and spawning, rearing and migration.

A map folio entitled Aquatic Resource Inventory-Stewart River/ Atlin Areas was produced as a part of this project and can be ordered through the Land Planning Branch, Department of Renewable Resources, Government of Yukon.

ABSTRACT

A biophysical stream inventory and fish habitat evaluation was carried out during the summer of 1982 on 65 streams in the Stewart River drainage near Mayo, Yukon and 33 streams east of Atlin, British Columbia. The purpose of the study was to test and develop a methodology for stream habitat inventory and evaluation to be used to classify the fisheries importance of stream reaches in the Yukon River Basin.

The inventory methodology employed during the survey was a slightly modified form of that developed by the Water Management Branch, B.C. Ministry of Environment.

The report summarizes the results of the survey in terms of fish distribution and habitat utilization. Arctic grayling (Thymallus arcticus), and chinook salmon (Oncorhynchus tshawytscha) were the main species of sport and commercial importance captured during the survey. Data are presented for observed grayling habitat preference in terms of habitat type, depth, velocity, and cover. Stream reach descriptions and habitat evaluations are included for each reach surveyed.

A proposed stream classification system is discussed and recommendations are made regarding appropriate stream inventory and evaluation methodology.

It is concluded that the inventory methodology used for the survey provides an adequate level of data on which to base a habitat evaluation and would be the most practical to implement on a basin-wide scale. A numerical rating system for reach habitat parameters is suggested as a means of standardizing the habitat evaluation process.

ACKNOWLEDGEMENTS

The author wishes to acknowledge: Dan Davies, who helped to design the project, aided in data collection and made valuable comments and suggestions throughout; Clive Osborne and Kevin Onclin who also assisted in data collection and preparation; Ted Harding, Tom Chamberlin, Gordon Ennis, and Gerry Whitley who reviewed the manuscript and contributed valuable suggestions.

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1.0 INTRODUCTION

The Yukon River Basin supports the third largest Pacific salmon (Oncorhynchus sp.) run in North America, as well as important populations of freshwater species such as lake trout (Salvelinius namaycush), whitefish (Family coregonidae), northern pike (Esox lucius), and Arctic grayling (Thymallus arcticus). These fish populations sustain significant commercial, native subsistence, domestic and sport fisheries, and are one of the Basin's most important renewable resources.

Along with development of the resources of the Yukon River Basin, it is inevitable that conflicts will arise between the fisheries resource and other competing uses of water and aquatic habitat (eg. hydroelectric generation, mining, transportation, etc.). It is therefore desirable to develop a system to evaluate units of stream habitat in terms of the importance of the fisheries resource, so that rational management decisions can be made.

One objective of this project was to implement and test an evaluation system in the Yukon River Basin which could be based on a low cost biophysical inventory requiring limited ground sampling and which could cover extensive areas in a

short period of time. This sytem could then be used to evaluate fisheries habitat over large areas and in response to a variety of resource developments.

A prerequisite for any habitat evaluation system is the establishment of habitat preference criteria for the important fish species involved (Bovee, 1982). In most cases, these habitat criteria have not been developed for species within the River Basin. Therefore, the study design included collection of habitat preference data as a first step in the evaluation process.

The immediate objective of this project was to provide the information necessary to classify stream fish habitat according to species presence and habitat quality for two important placer mining areas within the River Basin.

The project had four main objectives:

1. gather fish distribution and fish habitat inventory information for the two study areas;
2. develop basic habitat preference criteria for the main species present;
3. test a working model for evaluating stream habitat quality; and
4. recommend stream reach classifications based on species presence and habitat quality for streams within the study areas.

The two areas studied were:

1. a portion of the Stewart River drainage, near Mayo, Yukon; and
2. an area east of Atlin Lake, near Atlin, British Columbia (see figure 1).

Study streams in the Stewart River area were chosen by the Department of Fisheries and Oceans, District Office, Whitehorse, Yukon. Streams in the Atlin area were selected by the British Columbia Fish and Wildlife Branch, Region 6, Smithers, British Columbia.

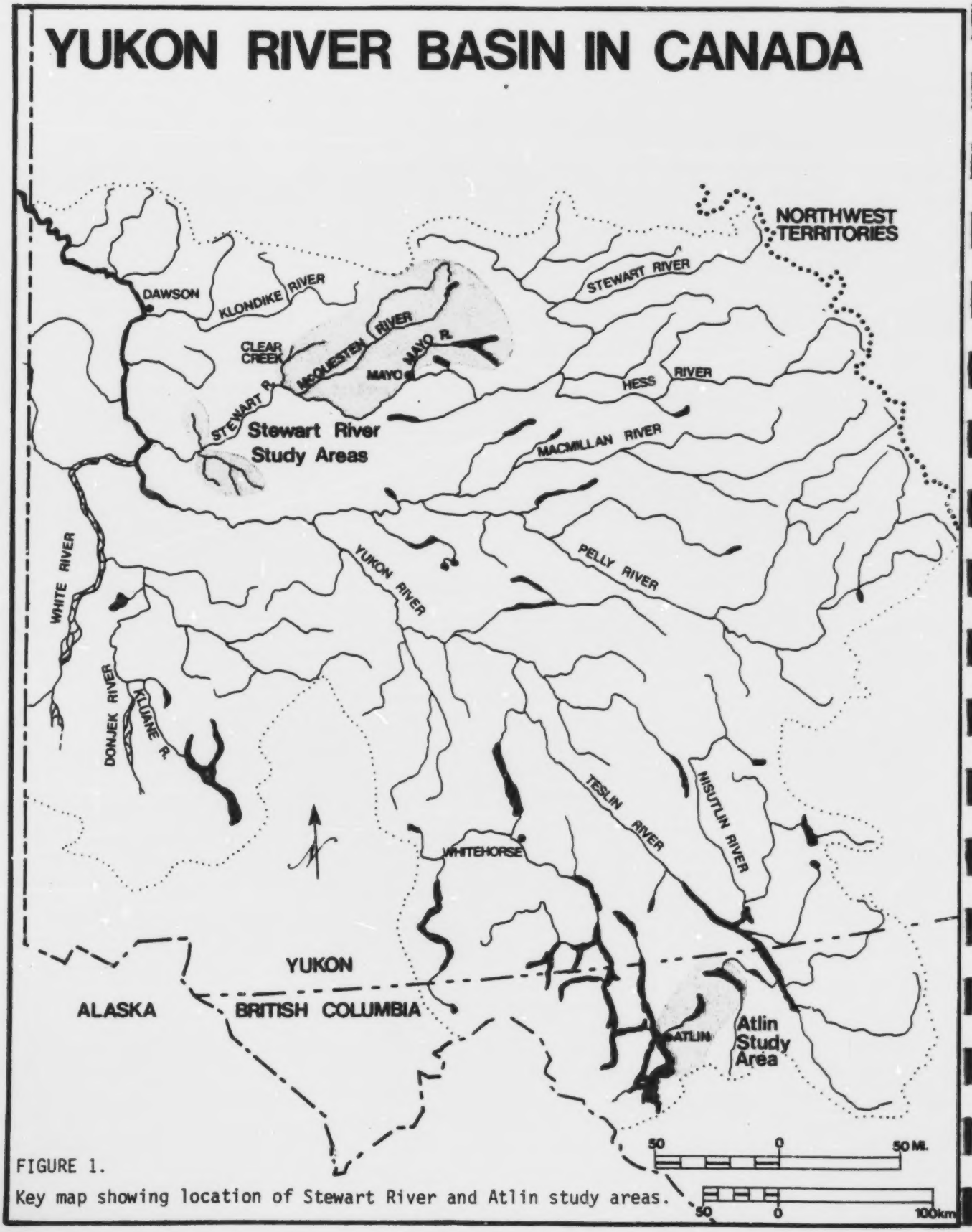

FIGURE 1.
Key map showing location of Stewart River and Atlin study areas.

2.0 STUDY AREAS

2.1 Stewart River Area

A total of 65 streams were surveyed along the Stewart River drainage from Barker Creek, near the mouth of the Stewart River, upstream to the Mayo River system (for list of streams surveyed see Table A1, Appendix A). The majority of the streams surveyed were in the Clear Creek, McQuesten River, and Mayo River drainages.

The Stewart River study area lies mainly in the Stewart Plateau physiographic region (Bostock, 1948), with portions in the Klondike Plateau (Barker/Scroggie Creek) and Tintina Trench (Clear Creek) regions. The eastern part of the study area was glaciated by one or more glacial advances, while the portion west of McQuesten River is largely unglaciated (Bostock, 1948). In the eastern portion, the lower slopes are deeply mantled with morainal and glaciofluvial material, while the larger valley bottoms (eg. Mayo and McQuesten) are filled with silty, glaciolacustrine deposits (Oswald and Senyk, 1977). The Tintina Trench area has extensive surficial deposits of gravel, sand and clay. In the unglaciated western part of the study area, valley bottoms are mainly filled with deep fluvial deposits (Geological Survey of Canada, 1942).

Elevations in the Stewart study area range from 360 m at the mouth of Barker Creek to nearly 2000 m in the Keno Hill area.

Climate in the area is characterized by long, cold winters and short, warm summers. Precipitation varies depending on terrain and elevation, but is generally greatest in June, July, and August (Wahl, unpublished). Selected climate data for the two study areas is presented in Appendix F.

Ice breakup in the larger rivers in the area generally occurs in early May (Water Survey of Canada, 1981/82). Peak flows generally occur shortly after breakup, with occasional maximum summer peaks corresponding to storm events (Orecklin and McLachlan, 1982). Ice-free low flows usually occur in late August or September. Absolute low flows occur in late winter. Many of the smaller tributaries may freeze right to the bottom during winter, thereby reducing available habitat for fish.

Over 60% of the drainages surveyed in the Stewart area have placer mining activity of varying intensity and virtually all are considered to have placer mining potential (Debicki, 1983). In those areas where placer mining has

occurred, natural stream habitats (in terms of channel configuration, stability, riparian vegetation, etc.) have generally been altered - in some cases extensively. The degree to which streams have been affected depends on the location and type of placer operation involved.

2.2 Atlin Area

A total of 33 streams were surveyed in the area to the east of Atlin Lake (for list see Table A2, Appendix A). The three main drainages surveyed were O'Donnel River, Pine Creek and Fourth of July Creek.

The Atlin study area lies in the Teslin Plateau Physiographic Region (Bostock, 1948). This area was glaciated during the last advance, and glacial drift fills most of the valley bottoms (Geological Survey of Canada, 1960).

Elevations range from 670 m at Atlin Lake to approximately 2070 m. The upper portions of the three main drainages occupy fairly broad, gently sloping valleys in the 900-1050 m range.

The climate of the Atlin area is moderated somewhat by the presence of Atlin lake (Wahl, unpublished). Winter temperatures are milder and summer temperatures slightly cooler than the Stewart River area. Precipitation is light and more evenly distributed throughout the year (see Appendix F).

Breakup would be expected to occur slightly earlier in the Atlin area. The smaller streams in this area also may freeze to the bottom in winter.

Virtually all of the drainages surveyed have active placer work of some type - many (eg. Pine C., Spruce C., Otter C., Boulder C., etc.) have been extensively mined since the early 1900's (Debicki, 1983). Habitat alterations are extensive in some areas.

3.0 METHODOLOGY

In order to achieve the objectives of the project, it was necessary to conduct the survey at two different scales. A baseline inventory approach was used to determine overall fish distribution and identify broad macrohabitat units. More intensive and detailed microhabitat work was necessary to determine habitat preference criteria.

Baseline aquatic inventory data were collected using methodology developed by the Water Management Branch (formerly Resource Analysis Branch), British Columbia Ministry of Environment (Chamberlin, 1980[1]). This stream inventory system includes methodology for data collection, mapping, storage and retrieval, and was previously used in Yukon by the Ecological Land Survey carried out by the Government of Yukon (Davies et al, 1983).

One facet of the storage and retrieval system is the assignment of watershed code numbers to identify stream systems. Watershed code numbers for these areas surveyed are included in Tables A1 and A2, Appendix A.

The survey methodology involves stratification of streams into "reach" units - each with relatively homogeneous physical properties. Pre-typing of streams is done from air photos to identify probable reach boundaries and significant features such as falls. Final stream typing and reach descriptions are done by aerial survey.

The types of information collected during the aerial survey include substrate composition, channel pattern, channel width, channel stability, bar presence, vegetation cover, etc. An example of the reach data card is included in Appendix D. Definitions of survey terminology can be found in Chamberlin (1980[2]).

The aerial reach descriptions are backed up by ground sampling information (or "Point" samples) which include measurement of physical parameters such as width, depth, velocity, etc. (see example, Appendix D). Fish sampling to determine fish presence is carried out at each ground site, using a variety of methods. The results of this sampling, combined with any existing fish information are then used to determine fish distribution.

During this survey, electrofishing was done at virtually every site using a Smith-Root Type V111A electrofisher. Areas inaccessible to electrofishing (ie. too deep or fast flowing) were sampled by angling with spinning tackle. Beach seining was done at several sites and monofilament gill nets (2 and 2.5 inch mesh sizes) were used at sites on the Mayo and Stewart Rivers. A swim survey using wet suits, mask, and snorkel was carried out on one section of the North McQuesten River. Any visual observations of fish were also recorded at all sites.

For this study, several additions were made to the usual survey information collected. During aerial surveys, estimates were made of the composition of each reach in terms of habitat type. Three habitat types were defined - pool, riffle, and glide (for definitions see Section 4.2) - and estimates made of the percentage of each habitat type within the reach. Estimates were also made of the percentage of each reach having different classes of surface flow character - placid, swirling, rolling, broken, and tumbling (for definitions see Chamberlin (1980[2])). It was felt that these parameters would help to describe the available fish habitat more accurately.

A slightly modified field data card was also developed to facilitate data recording at ground sample sites (see example, Appendix D). Physical measurements were made for a series of habitat types at a given location, rather than a single habitat type. These additional habitat data were used to develop a more empirical definition of the three habitat types in terms of depth, width-depth ratio, velocity, flow character, and substrate.

Velocities at most ground sites were measured using a Marsh-McBirney Model 201 electronic flow meter, the remainder were estimated using the timed floating chip method.

During fish sampling, records were kept of the habitat type, depth, velocity, and cover type associated with individual fish as they were captured. These data were then used to indicate habitat preference for different size classes of the species sampled.

In addition, a rough indication of fish abundance of sample sites was generated by dividing the number of fish captured by the linear length of stream sampled.

The field work in the Stewart River area was carried out from June 22 - July 1, 1982 and August 23 - 28, 1982. Sampling in the Atlin area was completed from July 12 - 17, 1982 and September 7 - 9, 1982. A number of sites in each study area were resampled to detect possible changes in fish distribution.

4.0 RESULTS

4.1 Habitat Inventory and Fish Distribution

The results of the basic stream inventory are summarized on 1:100,000 maps arranged in map folio form (available through Dept. of Renewable Resources, Govt. of Yukon). These maps indicate watershed boundaries, reach breaks, stream features (such as falls or beaver dams), fish distribution by reach, and include a summary of several important parameters from the reach description.

In addition to the mapped information, complete reach and ground sampling data can be accessed through computer reports (available through Dept. of Renewable Resources, Govt. of Yukon - see Appendix E for examples).

4.1.1 Fish Distribution - Stewart River Area

Arctic grayling (Thymallus arcticus) and chinook salmon (Oncorhynchus tshawytscha) were the most numerous and widely distributed of the sport and commercial species sampled in the Stewart River area.

Grayling were extremely widespread throughout the study area and were generally the only species - sometimes with slimy sculpins (Cottus cognatus) found in the upper portions of the smaller tributaries. It is assumed that overwintering of grayling takes place in lakes and larger rivers, with fish utilizing the smaller streams only during summer months[1]. There appeared to be a general upstream migration of grayling of all size classes throughout the summer months. In late August, grayling were caught at several upstream sample sites which had no fish in July, while at others, densities appeared to be higher in the later sampling period.

Very few grayling fry were observed during the survey. These were restricted to the larger river systems (ie. McQuesten, South McQuesten) or near lakes having resident populations (ie. Minto Creek).

Adult chinook salmon and chinook salmon redds were observed in the Mayo and McQuesten Rivers during August. This species appears to spawn only in the mainstem of these systems.

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[1] Numerous studies of northern Arctic grayling populations indicate this general pattern - eg. Reed (1964), deBruyn and McCart (1974), Craig and Poulin (1975), Butcher et al (1981), etc.

Large numbers of chinook fry were observed in the mainstem Mayo and McQuesten Rivers in July, while none were captured in the smaller tributaries. By late August, however, fry had moved into the lower portions of most tributaries to McQuesten River, as well as Scroggie, Clear, and Moose Creeks (see Figures 2, 3 and 4). Similar migrations of chinook fry into smaller streams have been noted by Davies and Shepard (1981), among others.

Lake trout (Salvelinus namaycush) are present in Mayo, McQuesten, and Minto Lakes, but were not captured during stream surveys.

Lake whitefish (Coregonus clupeaformis) were caught only in the lower Mayo River. They are probably restricted to low velocity sections of larger rivers or adjacent to lakes.

Round whitefish (Prosopium cylindraceum) were sampled from Barker Creek, Clear Creek, McQuesten River, and Mayo River. They appear to be present in relatively small numbers in all the larger rivers, as well as the lower reaches of many smaller tributaries.

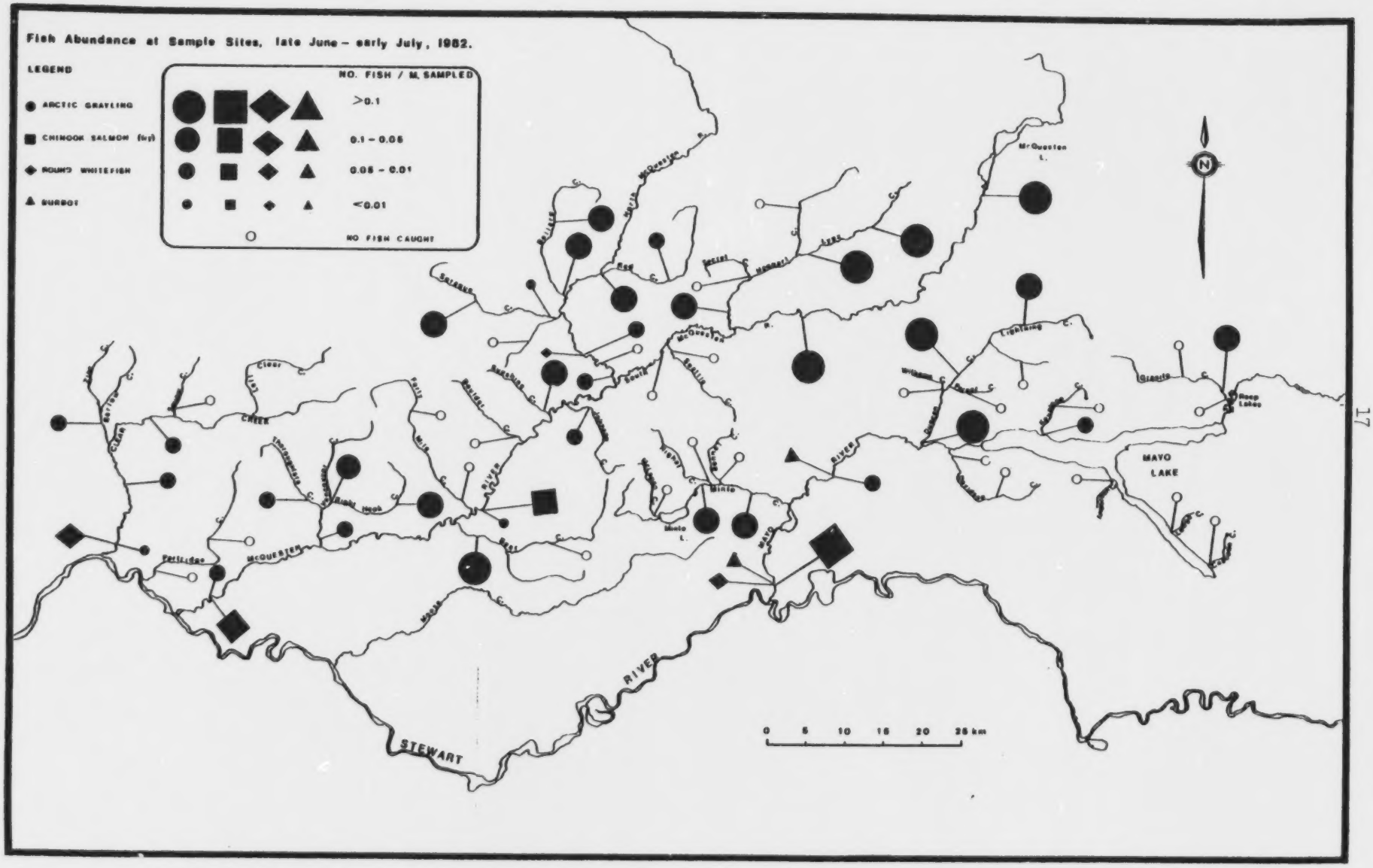

FIGURE 2. Map of McQuesten/Mayo area showing fish abundance at sample sites - late June-early July, 1982.

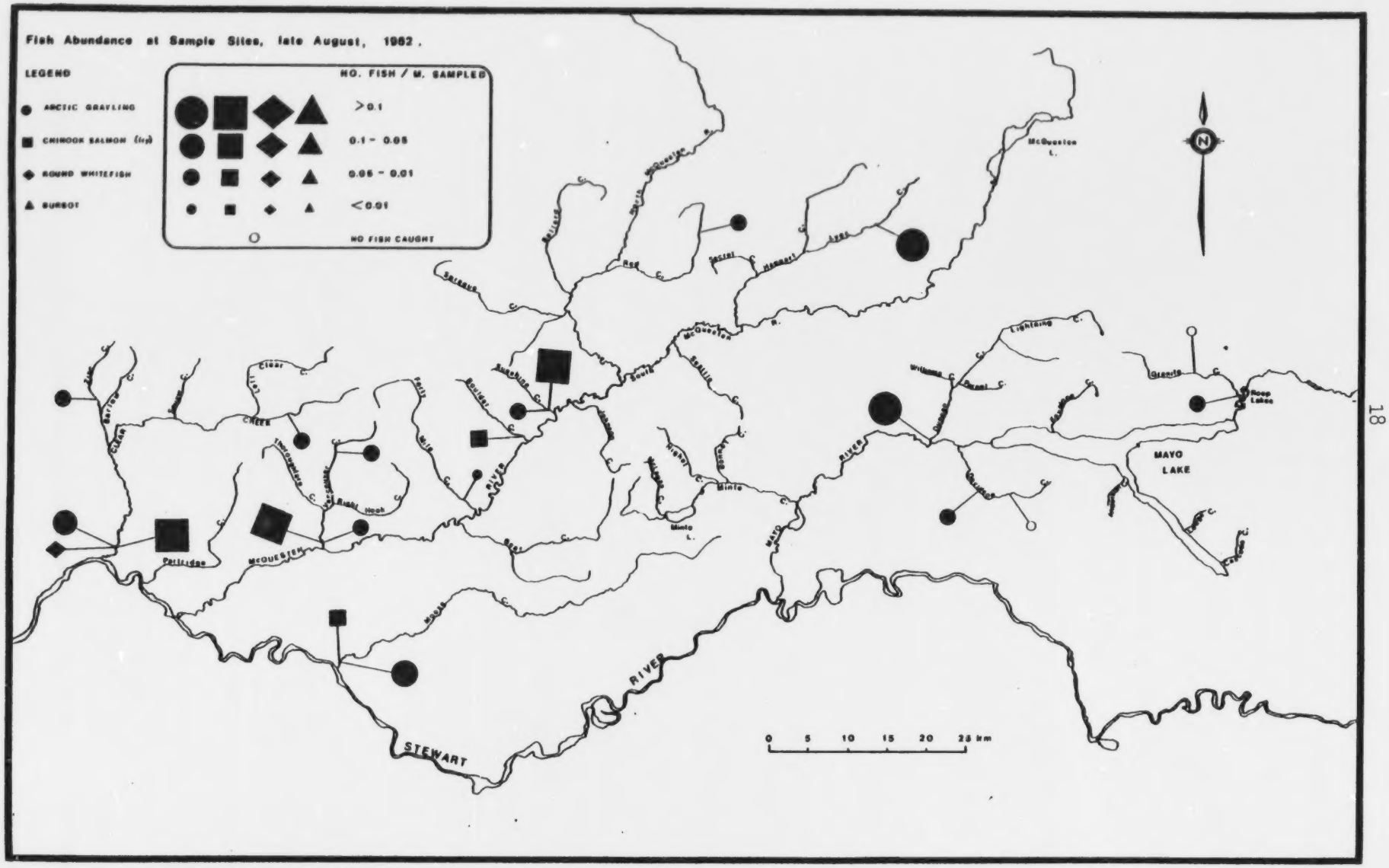

FIGURE 3. Map of McQuesten/Mayo area showing fish abundance at sample sites - late August, 1982.

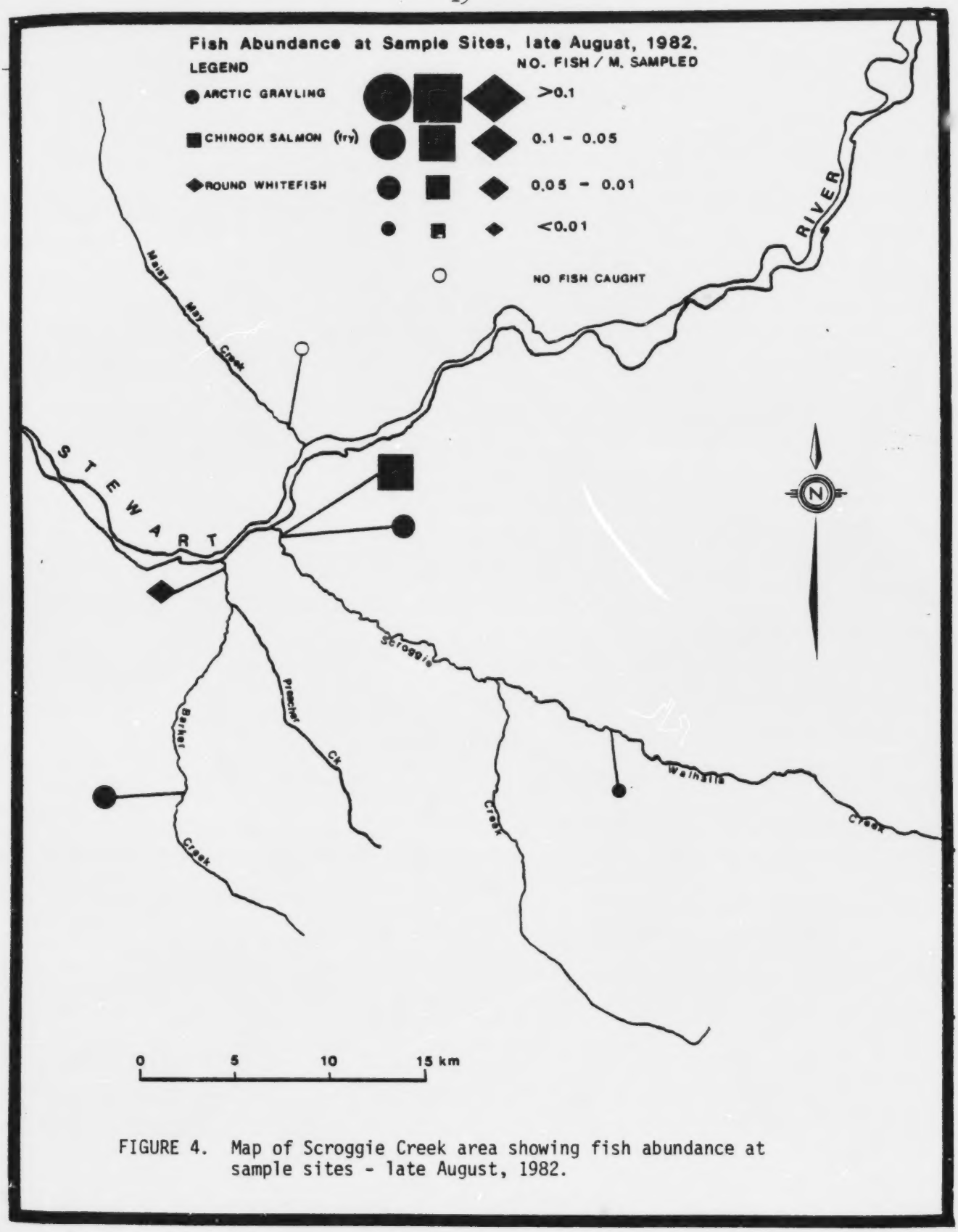

FIGURE 4. Map of Scroggie Creek area showing fish abundance at sample sites - late August, 1982.

Northern pike (Esox lucius) were captured only from the Stewart River, but are undoubtedly also present in low gradient areas of the larger systems (ie., Mayo and McQuesten Rivers).

Burbot (Lota lota) were captured in the Stewart and Mayo Rivers and are probably present in relatively small numbers in most larger streams and the lower portion of some smaller tributaries.[1]

Longnose suckers (Catastomus catostomus) were sampled from Clear Creek, McQuesten River, and Mayo River and likely have a distribution similar to round whitefish.

Slimy sculpins are extremely widespread in this area and were captured from the Stewart River to the upper reaches of many small tributaries.

Lake chub (Couesius plumbeus) were found only in the Stewart River.

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[1] Burbot were also captured in Lynx Creek in 1983 field season.

4.1.2 Fish Distribution - Atlin Area

The only species captured during fish sampling in the Atlin area were Arctic grayling, slimy sculpins, lake trout, and longnose suckers.

Grayling and sculpins were very widespread throughout the study area (see Figure 5 for grayling distribution and abundance). These species were found in the mainstem of the three major systems (C'Donnel, Pine and Fourth of July) and in virtually all accessible tributaries.

Grayling fry were observed only in Pine Creek - just below and just above Surprise Lake.

A single lake trout specimen was captured in Fourth of July Creek above McDonald Lake. This species is undoubtedly present in McDonald Lake and probably the other smaller lakes in the system. This is somewhat of an anomaly, as there is a steep canyon section in the lower portion of the creek which appears impassable. Longnose suckers were captured in Fourth of July Creek below this canyon.

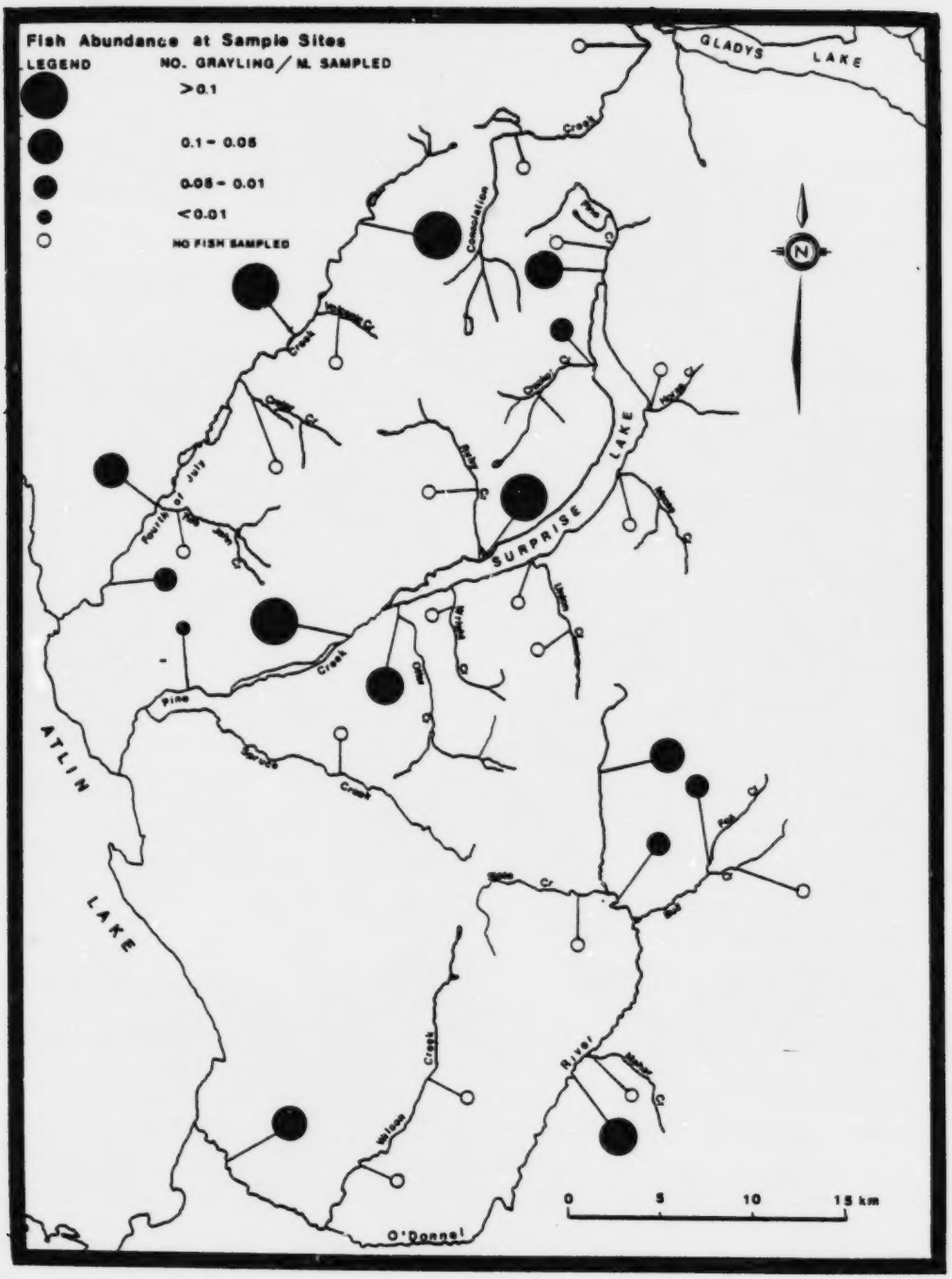

FIGURE 5. Map of Atlin area showing fish abundance at sample sites - July, 1982.

Surprise Lake, which also has an impassable falls downstream, appears to contain only grayling and sculpins.

Round whitefish, burbot, longnose suckers, and, perhaps, pike and juvenile lake trout may also be present in the lower portions of all three Atlin Lake streams.

Slimy sculpins were the only species captured in Consolation Creek - a Gladys Lake tributary. The lake is reported to contain lake trout, grayling, whitefish, burbot, and pike (L. Enders., personal communication).

Repeat sampling in the Atlin area was insufficient to determine if the general upstream migration of grayling noted in the Stewart River region also took place in this area.

4.2 Habitat Type Definitions

Definitions of pool, glide and riffle habitat types were developed prior to the field surveys and were subsequently refined using physical measurements of actual ground sites. Table 1 indicates the mean values and ranges for various parameters as measured in the field.

TABLE 1 Mean values for physical parameters of three habitat type classes as measured during field sampling.

Habitat Type		Width: Depth Ratio[1]	Max. Depth (cm)	Av. Depth (cm)	Velocity (m/sec.)	Slope (%)	Flow Character[2] (%) P	S	R	B	T	Substrate[3] (%) F	SG	LG	C	B	BR
Pool	$\bar{x}$	7.2	103.8	72.0	0.40	0.5	17	70	11	2	0	23	21	23	25	6	1
	S.D.	4.3	49.0	37.0	0.34	0.4	30	33	21	14	0	24	14	11	19	12	8
	Range	2.3-25.5	30-250	20-200	0-2.0	0-2.0	0-100	0-100	0-100	0-100	0	0-100	0-60	0-40	0-60	0-60	0-60
	n	53	53	54	52	24			55					54			
Glide	$\bar{x}$	10.8	78.3	48.8	0.51	0.6	23	54	22	1	0	23	17	26	26	8	0
	S.D.	5.8	51.0	32.5	0.29	0.3	34	35	31	7	0	30	14	15	20	18	0
	Range	1.9-30.0	25-200	15-150	0.1-1.5	0-1.0	0-100	0-100	0-100	0-50	0	0-100	0-60	0-50	0-60	0-80	0
	n	45	45	46	47	31			48					47			
Riffle	$\bar{x}$	19.8	42.7	28.1	0.78	2.0	0	11	69	15	4	6	13	26	38	17	0
	S.D.	16.9	31.8	22.9	0.35	1.3	2	19	26	18	18	8	9	11	15	19	0
	Range	4.2-100	12-220	5-180	0.2-1.9	0.1-5.0	0-20	0-80	0-100	0-80	0-100	0-50	0-40	0-50	0-70	0-80	0
	n	71	71	71	70	35			71					72			

[1]Wetted Width: Maximum Depth

[2]P = Placid
S = Swirling
R = Rolling
B = Broken
T = Tumbling

[3]F = Fines (2mm)
SG = Small gravel (2 - 16 mm)
LG = Large gravel (16 - 64)
C = Cobble (64 - 256 mm)
B = Boulder (256 mm)
BR = Bedrock

TABLE 2 Definitions of three habitat type classes in terms of slope, depth, velocity and flow character.

	SLOPE	DEPTH	VELOCITY	FLOW CHARACTER
POOL	-low - generally less than 1% (mean=0.5%)	-relatively deep -width:depth ratio generally less than 10 (mean=7.2)	-relatively low average velocity (mean=o.4m/sec.)	-mainly placid and swirling (mean=87% placid/ swirling)
GLIDE	-relatively low -generally less than 1% (mean=0.6%)	-shallow to relatively deep with uniform depth throughout -width:depth ratio variable (mean=10.8)	-relatively low with fairly uniform velocity (mean=0.5m/sec.)	-mainly placid and swirling (mean=77% placid/ swirling)
RIFFLE	-moderate to high -generally greater than 1% (mean=2.0%)	-relatively shallow -width:depth ratio generally greater than 10 (mean=19.8)	-moderate to high (mean-0.8m/sec.)	-mainly rolling and broken (mean=84% rolling/ broken)

The definitions, which follow (see Table 2) are necessarily somewhat relative - reflecting differing widths and gradients of streams surveyed. For example, wetted widths at sample sites varied from 50 m to less than 2 m. Such variation will obviously result in large differences in parameters such as maximum depth and width-depth ratio (note ranges in Table 1).

4.3 Habitat Preference

Detailed habitat preference data were compiled for Arctic grayling only. Other species were not captured in large enough numbers to be statistically significant. Sufficient subjective observations were made, however, to provide a general indication of habitat utilization for chinook salmon fry in the Stewart River area.

4.3.1 Chinook Fry

Chinook fry tended to be found in shallow, low velocity areas along the channel margins of larger rivers (ie. McQuesten and lower Mayo) throughout the summer months. Fry tended to utilize flowing water rather than zero-velocity, back channel areas. Cover was used, when available, but did not appear to be an important factor in habitat selection.

By late summer, significant numbers (several individuals per linear metre of stream at some sample sites) of chinook fry were found in the lower reaches of most smaller tributaries adjacent to the salmon-producing rivers. Fry in these smaller streams appeared to be fairly uniformly distributed throughout the shallow, low velocity portions of all habitat types. Fry were not found in stream reaches with slopes greater than about 4%.

The numbers of fish utilizing any individual stream may depend, to a large extent, on the location of the mainstem spawning areas (where the fry originate in the spring) in relation to the mouth of the stream. If there are extensive spawning areas near, or just upstream from, the mouth of a tributary, that tributary (providing the habitat is suitable) would likely be heavily utilized for late-summer rearing.

4.3.2 Grayling

In order to analyse the habitat utilization data (which follows), grayling were arbitrarily placed in 3 fork length categories: less than 15 cm; 15 - 30 cm; and greater than 30 cm. These length categories are roughly equivalent to the following age class categories: 0 - 2 years; 3 - 6 years; 7

years and greater (see Appendix C and Pendray (1983) for relevant age-length data) [1].

Data from the two study areas have been combined as the results from each area appeared to be similar.

Due to the fairly general nature of the data (and the qualifications discussed in Section 5.1) complex statistical analyses have not been undertaken.

4.3.2.a Habitat Type

Of the total number of grayling from both study areas, 59.0% were associated with glides, 29.7% with pools, and 11.3% with riffle habitat (see Table 3). Smaller fish tended to utilize glide habitat (86.1% of grayling less than 15 cm and 65.5% of those 15 - 30 cm), while larger fish were captured most often in pools (76.8% of those greater than 30 cm).

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[1] These are rough groupings only. Pendray (1983) found significant variations in age-length relationships within the Stewart River study area.

TABLE 3 Habitat type utilization by grayling of three length classes using combined data from Stewart River and Atlin Study areas.

Habitat Type		Fork Length: Less Than 15 cm	15 - 30 cm	Greater than 30 cm	Total Population
Pool	n	5	15	43	63
	%	6.9%	17.9%	76.8%	29.7%
Glide	n	62	55	8	125
	%	86.1%	65.5%	14.3%	59.0%
Riffle	n	5	14	5	24
	%	6.9%	16.7%	8.9%	11.3%
Totals	n	72	84	56	212
	%	34.0%	39.6%	26.4%	100%

These figures may be affected slightly by sampling bias. Fish sampling by electrofisher is generally more effective in shallower, lower velocity habitats than in deeper, swifter areas. Therefore, sampling efficiency in glides may be slightly greater than in either pools (generally deeper than glides) or riffles (generally higher velocity).

The fact that 88.7% of all grayling sampled (ie. all size classes) were associated with either pool or glide habitat, however, seems to indicate that these lower velocity, deeper areas are the preferred grayling habitats.

TABLE 4 Summary statistics for water depth at which grayling of three length classes were captured - using combined data from Stewart River and Atlin Study areas.

Fork Length	Mean Water Depth (cm)	Standard Deviation	Range (cm)	n
Less than 15 cm	30.8	15.9	20 - 100	57
15 - 30 cm	50.2	27.1	15 - 120	53
Greater than 30 cm	75.8	34.9	25 - 150	49
Total Population	51.1	32.2	15 - 150	159

4.3.2.b Depth

The mean depth for all fish sampled was 51 cm (see Table 4). Although there was a large overlap in the depths utilized by the different size classes, there appeared to be a definite trend for larger fish to be associated with deeper habitats. The mean depth at which fish greater than 30 cm were captured was 76 cm, while the mean depth for fish less than 15 cm was 31 cm.

The depth parameter was affected to a large degree by habitat availability, as most sample sites were on small streams with maximum depths of 1 m or less. Some sampling bias is also inevitable, because fish sampling generally becomes more difficult with increasing depth.

TABLE 5 Summary statistics for streamflow velocity at which grayling of three length classes were captured - using combined data from Stewart River and Atlin Study areas.

Fork Length	Mean Velocity (m/sec.)	Standard Deviation	Range (m/sec.)	n
Less than 15 cm	0.24	0.17	0 - 0.7	66
15 - 30 cm	0.32	0.32	0 - 1.0	77
Greater than 30 cm	0.40	0.24	0.1 - 1.0	48
Total Population	0.31	0.26	0 - 1.0	186

4.3.2.c Velocity

The mean velocity for all fish sampled was 0.31 m/sec. (see Table 5). Grayling were not captured in areas with velocities greater than 1 m/sec. Once again, there were large overlaps in velocities utilized by different size classes, but there was a clear tendency for larger fish to be associated with higher velocities. The mean velocity at which fish greater than 30 cm were captured was 0.40 m/sec., while the mean velocity for fish less than 15 cm was 0.24 m/sec.

The velocity preference data may also be affected somewhat by sampling bias, as fish sampling difficulty tends to increase with higher velocities.

TABLE 6 Cover type utilization by grayling of three length classes using combined data from Stewart River and Atlin Study areas.

Cover Type		Fork Length: Less than 15 cm	15 - 30 cm	Greater than 30 cm	Total Population
None	n	35	36	22	93
	%	61.4%	65.4%	46.8%	58.5%
Debris	n	5	5	21	31
	%	8.8%	9.1%	44.7%	19.5%
Overhang	n	0	5	4	9
	%	0	9.1%	8.5%	5.7%
Turbidity	n	17	9	0	26
	%	29.8%	16.4%	0	16.4%
Totals	n	57	55	47	159
	%	35.8%	34.6%	29.6%	100%

4.3.2.d Cover

Four categories of cover were identified: - debris, overhang (either bank or vegetation), turbidity, and "no cover". Turbidity was included because there were numerous cases where fish in turbid streams were found to be utilizing open, shallow areas which would likely not be used in areas with clear water. "No cover" refers to no overhead cover - in some cases fish in this category may have been using boulder or rippled surface water to provide cover.

A major factor influencing the data is simply the availability of the different cover types. Throughout much of the Atlin study area, for example, there is very little stable debris for cover. In approximately 15% of the fish sampling sites, turbidity (associated with placer activity) was considered to be a significant cover component (ie. visibility was 20 cm or less).

The data (summarized in Table 6) indicate that the majority of the fish sampled (58.5%) were associated with "no cover". This may be somewhat misleading, however, as our field observations suggest that while grayling did appear to hold most often in open "feeding stations", there was usually some form of overhead cover available to be used as "escape terrain" when fish were disturbed. This was especially true in smaller streams.

Approximately 30% of grayling less than 15 cm and 16% between 15 cm and 30 cm were utilizing turbidity for cover. This should not be interpreted as indicating a preference for turbidity in juvenile grayling, but it does indicate that turbidity is utilized for cover when available. In terms of cover requirements, the presence of turbidity may increase the area of stream suitable for juvenile rearing. It should be pointed out, however, that no adult grayling (ie. over 30 cm) were captured in turbid water.

The data also indicate that larger fish tended to be associated with some form of cover more often than smaller fish. If turbidity and "no cover" categories are combined (ie. no physical overhead cover), 91.2% of grayling less than 15 cm and 81.9% of fish 15 - 30 cm would be in this category, while only 46.8% of those over 30 cm used no overhead cover. 44.7% of grayling over 30 cm were associated with debris cover, indicating that debris is an important cover component for adult fish.

4.4 Habitat Evaluation

Table B1, Appendix B, presents reach descriptions and habitat evaluations for each reach surveyed during the project. Habitat evaluations have been based on a subjective assessment of several reach parameters (eg. percentage of pool/glide habitat, reach slope, flow character, etc.) which appear to relate to habitat quality, particularly for Arctic grayling.

For the Stewart River study area, Table B1 includes a recommended stream classification for each reach using the proposed classification system outlined in the Yukon Placer Mining Guidelines (Draft), (Dept. of Indian Affairs and Northern Development et al, 1983). For the Atlin area, a

subjective assessment has been made of the relative fisheries value of each reach rated as nil, low, moderate, or high.

The stream reach classification system as outlined in the (Draft) Placer Mining Guidelines, is based on a division of fish species into 2 schedules - Schedule I, containing salmon (Oncorhynchus sp), trout (Salmo sp.), and char (Salvelinus sp.) and Schedule II, with all other sport and commercial species (grayling, whitefish, burbot, and pike).

Under this draft system, reaches are classified as follows (DIAND et al, 1983).

A - Schedule I spawning area
B - Schedule I rearing area
C - Good Schedule II habitat
D - Other Schedule II habitat
(or total absence of habitat)
X - Previously designated placer mining area

A and B reaches are, therefore, classified entirely by fish species presence (ie. the presence of Schedule I fish) and utilization by that species (ie. spawning or rearing). The information necessary to classify these reaches can be gathered by fish sampling and observation at the appropriate time of the year and no qualitative habitat evaluation is necessary.

The designation of C and D reaches, however, requires a qualitative evaluation of the physical habitat to determine whether or not it is "good" Schedule II habitat. Grayling are generally the most widely distributed of the Schedule II species - being found from the mainstem rivers to the headwaters of many small tributaries - and therefore the classification of C and D reaches is generally a question of the quality of the grayling habitat.

Using our physical habitat inventory information, along with fish sampling results and grayling habitat preference data, we have identified various reach parameters which appear to relate to habitat quality for Arctic grayling. These include parameters which may have a direct effect on habitat quality, such as the percentage of pool/glide habitat in a reach, as well as parameters having more indirect influence such as reach slope, channel width, surface flow character, channel confinement, and channel pattern. Obviously there are relationships between the parameters and it is a very complex interaction between all these (and probably other parameters) which determine habitat quality.

The recommended reach classification and fisheries value assessment which appears in Table B1 results from a

subjective evaluation of the parameters mentioned. The following simplified guidelines were used in the evaluation:

Percentage of pool/glide habitat - These appear to be the preferred habitat types for grayling. Therefore, generally the greater the percentage of pool/glide habitat, the higher the rating. Our observations, however, indicate that reaches with very high percentages of pool/glide may not be utilized as heavily as those with slightly less pool/glide. Therefore, very high pool/glide percentages (>80%) were rated slightly lower than those 50 - 80%.

Reach Slope - Grayling were generally not found at reach slopes greater than 4% and appeared most numerous at slopes less than 1.5%. Therefore, reaches with slopes greater than 4% were rated very low - reaches less than 1.5% were given the highest rating.

Channel Width - When channel widths are very small (ie. <2-3 m) there is very little useable area for fish, and therefore, a lower rating was given.

Surface flow character - This parameter relates closely to habitat type - generally, the greater percentage of rolling, broken, and tumbling flow, the greater is the area

of riffle habitat and therefore the poorer the grayling habitat.

Channel Confinement - Generally confined or entrenched reaches tend to be higher gradient and have fewer pools and glides, and therefore a lower rating.

Channel Pattern - Reaches with meanders generally are lower gradient and have greater pool/glide percentages, and better grayling habitat.

5.0 Discussion

5.1 Habitat Preference Results

There are a number of factors which may introduce bias into the grayling habitat preference data. These include:

1. The use of different fish sampling methods (with differing sampling effectiveness) for different habitat conditions.

2. Variations in sampling difficulty in different habitat types, flow conditions, turbidities, etc.

3. Differences in availability of habitat types from stream to stream.

These types of bias would likely be present, however, in any similar type of field study. While the data have some limitations, they do provide a starting point for the development of habitat preference criteria.

This type of detailed information is relatively time consuming (and therefore costly) to gather and cannot be duplicated in every inventory project. It is important, therefore, to assess the utility of the habitat preference data and determine whether they can be applied to other areas.

It would seem that the very basic habitat preference parameters such as depth and velocity depend, to a large extent, on the physiological and behavioural characteristics of the species and should be very widely applicable. Unfortunately, these parameters are not very useful in large-scale habitat evaluations because very detailed ground surveys are necessary to measure them.

The assessment of grayling preference by habitat type was included in the methodology because these are the most detailed habitat units which can be identified by aerial survey. Habitat type preference - which, by definition, reflects a preference for a certain depth and velocity combination - should also apply to other study areas. The definitions for habitat type, however, must be consistently applied in other areas (which may have different physiographic and hydrologic characteristics) and by other

surveyors. The percentage of habitat types may also vary depending on stream flow conditions. Grayling habitat type preference should be tested in other areas to ensure that similar relationships exist.

The next step in the process of refining our habitat evaluation techniques is to obtain correlations between all applicable reach parameters (eg. slope, channel width, channel pattern, etc.) and some measure of fish abundance (or fish capability). While our data indicates, for instance, that pool/glide habitat is preferred by grayling, we lack the data to determine what percentage of pool/glide is optimum for grayling on a reach basis. In the future, when some reliable measure of fish abundance is available, multi-variate analysis should be utilized to obtain these types of correlations. Until this work is done, we will have to continue to use subjective assessments to determine which reach slopes, percentages of habitat type, channel pattern, etc. are optimum for a given species.

5.2 Classification System

Numerous stream classification systems have been proposed or are currently in use in other parts of North America to serve a variety of resource management purposes (eg. B.C. stream classifications for placer mining, Washington State classifications for forestry, etc.). Few, if any, of these systems, however, have been designed to be multiple use classifications - ie. to be applied in any land use decision-making situation. The objective for the Yukon River Basin is to adopt a classification scheme which will classify the importance of fisheries habitat and which can be applied in any situation where there may be a conflict between the fisheries resource and competing users (eg. hydro-electric projects, corridor development, mining, etc.). Any regulations or mitigation requirement which may be attached to the classifications by different regulatory agencies will vary depending upon the type of development and should be recognized as being completely separate from the classification system.

A detailed discussion and comparison of possible classification systems which could be adopted for use in Yukon is, unfortunately, beyond the scope of this study. The brief discussion which follows will assess the classification system outlined in the (Draft) Yukon Placer Mining

Guidelines (see Section 4.4) and comment on its suitability for multiple use purposes.

When assessing this system, the following points should be considered:

1. In order for the classification system to be applicable in all situations, it should be ensured that the two fish species schedules reflect fisheries management priorities as well as sensitivity to sediment. Sediment may or may not be the most important environmental concern in other types of resource conflicts. Fisheries managers should therefore ensure that all the highest priority species are included in Schedule I.

2. In order that the classifications be assigned consistently and without bias, the criteria defining Class C and Class D reaches should be much more clearly defined (see examples in Section 5.4). In many areas of the Yukon River Basin, there is little or no fish or fish habitat information on which to base classifications. In these areas, criteria for classification could be greatly simplified and the resulting reach classifications clearly marked as "preliminary" to await the collection of confirming data.

3. The classifications are based stream reaches, and therefore the delineation of these stream reaches is a prerequisite for the implementation of the system. Reach delineation should also be done in a systematic fashion, using established criteria. Preliminary reach delineation could be done from maps, Landsat imagery, or air photos.

4. Under this system, even very lightly utilized or marginal habitat which has Schedule I fish present is implied to be more important than the most productive Schedule II habitat. There is also no distinction between this very marginal "A" or "B" habitat and those "A" or "B" reaches which are extremely heavily utilized. Some method should be considered to flag "A", "B", or "C" reaches which appear to provide habitat which is of extreme or critical importance to a fish population.

5.3 Inventory Methodology

A slightly modified form of the biophysical aquatic inventory system used by the Yukon Ecological Land Survey was adopted for this project. An evaluation methodology was built around this inventory system for the following reasons:

1. The system has low cost per area covered.

2. Large areas can be surveyed quickly.

3. A substantial portion of Yukon (ie. Southern Lakes and MacMillan Pass) has already been surveyed using this method.

4. The data storage and retrieval system is already in place.

Another advantage of this system is that it is based on the reach concept and it provides a systematic methodology for delineating reach boundaries.

This is a reconnaissance level inventory system intended to cover large areas at a 1:50,000 scale. The reach parameters, for instance, are averages which are designed to be estimated from the air rather than be precisely measured on the ground. While the level of detail can be scaled up slightly by increasing the density of ground sampling, it is still a survey designed for broad, basin-wide applications.

In any data gathering situation there is a compromise between the level of detail which can be gathered and the area which can be covered. Considering the very large areas of the Yukon River Basin which require evaluation and classification, we felt it necessary to opt for a broad-scale methodology. The level of detail provided by this methodology appears to be both appropriate and adequate to fit the evaluation and classification process. More detailed, ground-based surveys may be suitable in cases where, for instance, a reach classification may be appealed, but they are not feasible for use on a large scale.

The following recommendations can be made regarding the future use of the aquatic biophysical inventory system for habitat evaluation and stream classification:

1. An estimation of reach percentages of habitat type and flow character should be included in the methodology. Habitat type preferences should also be tested in other areas. Apart from these additions, the standard inventory methodology should be followed.

2. For most parts of the River Basin, field inventory should be carried out in July and August. Streams are generally in summer flow conditions at this time, allowing more effective fish sampling and habitat assessment. Grayling and chinook fry also tend to be at their maximum areal distribution.

3. The fish sampling density should be quite high and repeat sampling may be required to accurately determine fish presence and to identify any unusually productive sites.

4. Aerial surveys could be scheduled to correspond with salmon spawning, so that information can be collected on extent of spawning areas.

5.4 Evaluation Methodology

Reaches in the Stewart River area were classified according to the proposed placer mining classifications system (see Section 4.4). The classification into "A" and "B" reaches was, therefore, based on the presence of spawning or rearing Schedule I fish. This information was generally available for this area either from the fish sampling data collected during the survey or from previously conducted salmon inventories.

Problems were encountered, however, in determining the spawning and rearing utilization for lake trout. Lake trout generally spawn around lake margins, but have also been documented as spawning occasionally in rivers adjacent to lakes (Scott and Crossman, 1973). Little is known about the extent of lake trout river spawning in Yukon or the importance of inlet streams for lake trout spawning or rearing. More research into this aspect may be necessary in order to determine the appropriate reach classifications to be applied adjacent to lakes.

The classification of reaches into "C" and "D" categories required a qualitative evaluation of the reach data. This was carried out using the methodology outlined in Section 4.4. It is clear that some reach parameters (eg. slope) are very powerful indicators of habitat quality. For example, the slope values alone can be used to classify large portions of steep gradient habitat as "D" reaches.

The classification of "border-line" cases, however, still requires a subjective decision. A more precisely defined guide for splitting "C" and "D" classifications would be an obvious improvement in the classification system. One way of achieving this improvement would be the application of a numerical rating to the various habitat

parameters to generate an overall habitat rating for each reach. Such a numerical system would still have a subjective basis, but would provide a consistent method for evaluating the habitat data.

In areas which do not have systematically collected inventory information, a more simplified rating system could be applied, using criteria which are obtainable from topographic maps and air photos. The resulting preliminary classifications would be subject to possible revision when inventory information becomes available.

The following evaluation format is presented as an example:

Systematic inventory data available:

Schedule I (spawning) fish present or suspected--Class A

Schedule I (rearing) fish present or suspected--Class B

If no Schedule I fish present or suspected:

Parameter	Range of Values	Limitation Rating
Fish Presence	Schedule II fish present or suspected	0
	No Schedule II fish present or none suspected	5
Slope (%)	0 - 1.4	0
	1.5 - 2.5	1
	2.6 - 3.9	2
	4.0 - 5.0	3
	>5	5
Pool/glide %	>80%	1
	50 - 80%	0
	25 - 49%	1
	>25%	2
Channel Width (m)	>5	0
	3 - 5	1
	>3	3
Flow Character %	<60% Rolling/Broken/Tumbling	0
	60 - 75% Rolling/Broken/Tumbling	1
	>75% Rolling/Broken/Tumbling	2
Confinement	Confined	1
	Entrenched	2
	Others	0

Limitation Rating totalling 5 or less--Class C

Limitation Rating >5 --Class D

No systematic inventory data available:

Schedule I (spawning) fish present or suspected--Class A

Schedule I (rearing) fish present or suspected--Class B

If no Schedule I fish present or suspected:

Parameter	Range of Values	Limitation Rating
Slope (%)	0 - 1.4	0
	1.5 - 2.5	1
	2.6 - 3.9	2
	4.0 - 5.0	3
	>5	4
Channel Width (m)	>5 m	0
	3 - 5 m	1
	<3 m	2

Limitation rating totalling 3 or less--Class C

Limitation rating >3--Class D

6.0 Conclusions and Recommendations

A stream classification system which would rate the fisheries value or sensitivity of individual stream reaches would be a valuable tool in resource-use decision-making and could be implemented throughout the River Basin.

The classification system proposed in the (Draft) Yukon Placer Mining Guidelines (DIAND, 1983) is suitable for the purpose if these recommendations are followed:

1. The two species schedules should accurately reflect fisheries management priorities.

2. The criteria for defining reach classes should be clearly outlined.

3. Classifications should be implemented consistently for a given level of available information, perhaps utilizing a numerical rating system.

The inventory methodology used in this study provides an adequate level of detail for implementation of a classification system and would be the most practical for use on a broad, basin-wide scale.

Further work to establish correlations between fish productivity and habitat parameters is necessary before truly objective habitat evaluations will be possible.

7.0 References

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APPENDIX A

List of watersheds in Stewart River
and Atlin study areas with
aquatic biophysical information

TABLE A1 List of watersheds in the Stewart River Study Area with aquatic biophysical information.

Name	Watershed Code Number
Stewart River	62
Barker Creek	62 0510
Preacher Creek	62 0510 020
"Unnamed" Creek	62 0510 020 100
Iron Creek	62 0510 180
Scroggie Creek	62 0570
Walhalla Creek	62 0570 340
Alberta Creek	62 0570 340 380
"Unnamed" Creek	62 0570 340 380 100
Maisy May Creek	62 0620
Clear Creek	62 1900
Barlow Creek	62 1900 150
Zinc Creek -	62 1900 150 030
Squaw Creek	62 1900 220
Left Clear Creek	62 1900 310
Partridge Creek	62 2020
McQuesten River	62 2110
Vancouver Creek	62 2110 100
Thoroughfare Creek	62 2110 100 010
Right Hook Creek	62 2110 100 020
"Unnamed" Creek	62 2110 100 030
Bear Creek	62 2110 250
"Unnamed" Creek	62 2110 250 050
Forty Mile Creek	62 2110 260
"Unnamed" Creek	62 2110 260 150
Boulder Creek	62 2110 370
Sunshine Creek	62 2110 400
Johnson Creek	62 2110 410
Sabbath Creek	62 2110 410 080
"Unnamed" Creek	62 2110 410 120
North McQuesten River	62 2110 470
Sprague Creek	62 2110 470 060
"Unnamed" Creek	62 2110 470 060 020
"Unnamed" Creek	62 2110 470 060 100
"Unnamed" Creek	62 2110 470 060 140
Gem Creek	62 2110 470 060 220
Ballard Creek	62 2110 470 070
Red Creek	62 2110 470 140
"Unnamed" Creek	62 2110 470 140 220
South McQuesten River	62 2110 480
Seattle Creek	62 2110 480 070
Morrison Creek	62 2110 480 070 080
"Unnamed" Creek	62 2110 480 070 080 080
Haggart Creek	62 2110 480 180
Swede Creek	62 2110 480 180 060
Lynx Creek	62 2110 480 180 160
Moose Creek	62 2550
Mayo River	62 3850
Minto Creek	62 3850 060
Bennett Creek	62 3850 060 110
Highet Creek	62 3850 060 120
Carlson Creek	62 3850 060 220
McLagan Creek	62 3850 060 230
Duncan Creek	62 3850 280
Williams Creek	62 3850 280 020
Parent Creek	62 3850 280 030
Lightning Creek	62 3850 280 150
McMillan Gulch	62 3850 280 150 060
Davidson Creek	62 3850 300
Keystone Creek	62 3850 420
Anderson Creek	62 3850 510
"Unnamed" Creek	62 3850 510 020
Cascade Creek	62 3850 590
Ledge Creek	62 3850 640
Granite Creek	62 3850 880 050

TABLE A2 List of watersheds in the Atlin Study Area with aquatic biophysical information.

Name	Watershed Code Number
Davenport Creek	67 9100 310
Consolation Creek	67 9100 320
O'Donnel River	69 9900 310
Wilson Creek	69 9900 310 020
Burdette Creek	69 9900 310 020 040
"Unnamed" Creek	69 9900 310 020 220
Canyon Creek	69 9900 310 110
Mahar Creek	69 9900 310 150
Nancy Creek	69 9900 310 230
Bull Creek	69 9900 310 280
Fox Creek	69 9900 310 280 030
Slate Creek	69 9900 310 310
McKinley Creek	69 9900 310 330
Feather Creek	69 9900 310 350
Pine Creek	69 9900 390
Spruce Creek	69 9900 390 010
"Unnamed" Creek	69 9900 390 010 060
Birch Creek	69 9900 390 030
Otter Creek	69 9900 390 050
Boulder Creek	69 9900 390 060
Wright Creek	69 9900 390 070
Ruby Creek	69 9900 390 090
Union Creek	69 9900 390 110
Quartz Creek	69 9900 390 130
Moose Creek	69 9900 390 150
Horse Creek	69 9900 390 190
Cracker Creek	69 9900 390 210
"Unnamed" Creek	69 9900 390 210 020
Cup Creek	69 9900 390 230
Fourth of July Creek	69 9900 410
Two John Creek	69 9900 410 030
Crater Creek	69 9900 410 070
Volcanic Creek	69 9900 410 110

APPENDIX B

Reach descriptions and habitat evaluations
for Stewart River and Atlin study areas

Reach Descriptions and Habitat Evaluations

The following table presents a reach-by-reach description and habitat evaluation for all streams surveyed in the Stewart River and Atlin study areas.

The recommended reach classifications for the Stewart River area follow the stream classification system proposed in the (Draft) Yukon Placer Mining Guidelines (DIAND 1983). The criteria used to assign the reach classes is outlined in Section 4.4. For the Atlin area, reaches were assigned a relative fisheries value rated as nil, low, moderate, or high.

Explanation of terms and abbreviations

Reach Number

Reach numbers are assigned sequentially from the mouth to the headwaters. "TS" after a reach number indicates that the survey was terminated in that reach - ie. the stream was not surveyed to its headwaters.

Reach Description

Reach descriptions generally refer to valley and stream channel characteristics taken from reach data cards. These include the relative width of the valley flat (narrow or V-shaped valleys or have "confined" channels), channel pattern (meandering, sinuous, straight, etc.), stream gradient (slope) and the percentage of habitat types.

Approximate Slope

Stream slopes are measured from topographic maps (usually 1:50,000). The accuracy of the slope figures is often questionable, especially for very short reaches. Brackets ( ) around a stream slope indicate that the figure recorded is not consistent with the observed habitat parameters and may be inaccurate.

Substrate

Substrate refers to the composition of the streambeds in terms of the relative proportions of four size classes of materials - fines (f,F) 0-2 mm, gravels (g,G) 2-64 mm, larges (l,L) >64mm, and bedrock (r,R). The substrate code indicates minor and major substrate components depending on the percentage of each size class present in the reach, as follows:

- 10% or less - very minor component - not coded
- 20 - 30% - minor component - indicated by lower case (f,g,l,r)
- >30% - major component - indicated by upper case (F,G,L,R)

Fish Species Present

Fish species not in brackets are confirmed to be present in the reach. Those in brackets ( ) have not been confirmed (sometimes because no fish sampling has been done), but are suspected to be present because the habitat appears suitable. The symbol " Ø " indicates "no fish species present". The following fish species abbreviations appear in the table:

AG - Arctic grayling
BB - Burbot
CCG - Slimy sculpin
CH - Chinook salmon
CS - Cisco (general)
IN - Inconnu
LSU - Longnose sucker
LT - Lake trout
LW - Lake whitefish
NP - Northern pike
RW - Round whitefish
WF - Whitefish (general)

STEWART RIVER STUDY AREA

Table B1. Reach descriptions and habitat evaluations for the Stewart River and Atlin Study areas.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Barker C. (62-0510)	1	7.0	Broad valley, low gradient, meandering. Some beaver dams. 70% pool/glide habitat.	6	0.6	fGl	AG, RW (CCG, CH, LSU)	B	Suspected CH rearing. AG habitat appears good. Subject to suspended sediment from U/S placer work.
	2	3.4	Frequently confined, low gradient. Some beaver dams. 50% pool/glide habitat.	5	0.4	GL	AG (CCG)	C	AG present, habitat appears good. Subject to suspended sediment from U/S placer work.
	3	6.4	Broad valley, low gradient, meandering. 70% pool/glide habitat.	5	0.9	fGl	AG (CCG)	C	AG present, habitat appears good. Subject to suspended sediment from U/S placer work.
	4 Ts	7.0	Moderate gradient, irregular meanders. 50% pool/glide.	4	2.3	gL	AG (CCG)	C	AG present, habitat appears good. Bench placer operation at lower end of reach.
Preacher C. (62-0510-020)	1	7.9	Broad valley, meandering 50% pool /glide.	4	2.1	fgL	(AG, CCG, RW)	C	AG suspected - gradient and habitat appear suitable.
	2 Ts	3.6	Small, frequently confined, moderate gradient. 50% pool/glide.	2	3.4	GL	(SP)	D	Small stream, marginal habitat.
Unnamed C. (62-0510-020-100)	1 Ts	1.4	Confined, moderate gradient. 60% riffle habitat.	2	3.4	gL	(SP)	D	Small stream, marginal habitat.
Iron C. (62-0510-180)	1 Ts	8.5	Frequently confined, irregular meanders. Some beaver dams. 60% pool/glide.	3	2.8	fgL	(AG, CCG)	C	AG suspected - habitat appears good.

Table 61, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Scroggie C. (62-0570)	1	24.1	Broad valley, low gradient meandering. 70% pool/glide.	12	0.4	fGl	AG, CCG, CH, LSU, RW	B	CH rearing in lower portion. Side channels and cut-offs afford good rearing habitat.
	2	6.6	Frequently confined, low gradient, meandering 60% pool/glide.	8	1.0	gL	AG (CCG , RW)	C	AG present, habitat appears good.
	3	3.0	Confined, moderate gradient. 70% riffle.	7	(0.7)	gL	AG (CCG)	C	AG present, habitat is fair.
	4 Ts	15.4	Frequently confined, meandering. 60% pool/glide.	7	1.5	gL	AG	C	AG present, habitat appears good.
Walhalla C. (62-0570-340)	1	24.7	Broad valley, very low gradient, meandering. 70% pool/glide	6	0.4	fGL	AG	C	AG present, habitat is fair.
	2 Ts	12.7	Broad valley, low gradient, meandering. Extensive beaver dams. 90% pool/glide.	4	0.9	Fg	(AG)	C	AG suspected, habitat appears only fair. Channel is overgrown with willow.
Alberta C. (62-0570-340-380)	1	3.0	Broad valley, low gradient, meandering.	5	1.1	Fgl	(AG)	C	Limited habitat information - appears similar to Walhalla, Reach 2.
	2	5.3	Frequently confined, some beaver dams. 60% pool/glide.	5	1.3	GL	(AG)	C	AG suspected, habitat appears suitable.
	3	1.9	Broad valley. 60% pool/glide.	5	1.6	GL	(AG)	C	AG suspected, habitat appears suitable.
	4 Ts	2.9	Confined, moderate gradient. Mainly riffle habitat.	4	(1.3)	gL	(Ø)	D	Habitat appears marginal.

Table B1. Continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Unnamed C. (62-0570-340-380-100)	1 Ts	3.0	Confined, mainly grown in with willow. Mostly riffle.	2	1.7	FG	(Ø)	D	Small stream, marginal habitat.
Maisy May C. (62-0620)	1	1.2	Unconfined fluvial fan area, low gradient. 90% pool/glide habitat.	4	0.8	FG	(AG, CCG, CH)	(B)	Suspect CH may rear in this reach. However, no fish were captured in sampling. Subject to very high suspended sediment from U/S placer work. Sedimentation may preclude fish utilization.
	2	10.7	Moderate confinement and gradient, irregular meanders. 60% pool/glide	4	1.2	fgL	(AG)	C	Habitat and gradient appear suitable. Subject to very high suspended sediment from U/S placer work.
	3 Ts	9.4	Extensively altered by placer activity. Several diversions and settling ponds appear impassable.	3	2.1	fGL	(Ø)	D	Existing habitat not suitable for fish due to alterations.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Clear C. (62-1900)	1	30.6	Broad valley, low gradient, meandering. 60% pool/glide.	15	0.4	GL	AG, BB, CCG, CH, LSU, NP, RW	B	CH rearing in lower portion. Subject to suspended sediment from U/S placer work. No CH spawning documented, but substrate and flows may be suitable.
	2	17.6	Confined, low gradient. Mainly riffle habitat.	15	0.8	gL	AG, CCG, RW	C	AG present - habitat fair. Subject to suspended sediment from U/S placer work.
	3	3.9	Moderately confined, mainly riffle habitat. Extensive alteration by placer operations.	15	0.9	fgL	AG, CCG, RW	C	AG present - habitat fair, but extensively altered. Subject to suspended sediment from U/S placer work.
	4	4.2	Moderately confined. Extensive alteration. Most of reach consists of diversion channels.	7	1.6	fgL	AG, CCG, RW	D	AG present, but habitat is very poor. Dredging operation present in this reach.
	5	8.5	Moderately confined, moderate gradient. 75% riffle.	7	2.5	gL	AG, CCG, RW	C	AG present - habitat fair. Some placer exploration, but no major alteration.
	6 Ts	6.0	Confined, steep gradient. 90% riffle.	5	6	L	(AG, CCG)	D	Steep gradient, marginal habitat. Mainly high velocity riffle.
Barlow C. (62-1900-150)	1	2.8	Broad valley, low gradient, meandering. 70% pool/glide.	7	0.8	fGl	AG (CCG)	C	AG present, low gradient. Substrate and flows appear suitable for spawning. Subject to suspended sediment from U/S placer work.
	2	2.4	Moderately confined, low gradient, meandering. Some placer work in lower portion. 60% pool/glide.	6	1.0	fGL	(AG, CCG)	C	Habitat appears good in undisturbed portion.
	3	1.6	Moderately confined. Moderate gradient.	5	1.3	gL	(AG, CCG)	C	AG suspected, habitat appears good.
	4	4.2	Confined, moderate gradient. 80% riffle.	5	2.7	gL	(AG, CCG)	D	Mainly shallow riffle habitat.
	5 Ts	2.9	Confined, steep gradient. 75% riffle.	4	4	gL	(AG)	D	Mainly high velocity riffle habitat.

Table B1. Continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Zinc C. (62-1900-150-030)	1	1.9	Moderately confined. 95% riffle.	3	1.3	fGl	AG (CCG)	D	AG present - abundance appears low. Small stream with little suitable habitat.
	2 Ts	6.1	Confined channel, moderate gradient. 70% riffle.	2	2.9	GL	AG	D	AG present - abundance appears low. Small stream - little suitable habitat. One bench placer operation present.
Squaw C. (62-1900-220)	1	5.4	Confined channel, moderate gradient. 70% riffle.	5	2.5	gL	AG, CCG	D	AG present - abundance appears low. Habitat mainly shallow riffle.
	2 Ts	2.3	Confined, steep gradient. 90% shallow riffle.	3	5	gL	(AG)	D	Steep gradient, shallow riffle habitat.
Left Clear C. (62-1900-310)	1	16.0	Confined valley. Extensively altered for placer work. Several obstructions. Mainly shallow riffle.	11	1.9	gL	(Ø)	(C)	Designated. Ag may be present in extreme lower end, but access is blocked by obstructions. Habitat is fair in places. Stream is beginning to return to more stable, natural conditions in some areas.
	2 Ts	3.2	Confined, steep gradient. All shallow riffle.	4	7	gL	(Ø)	D	Designated.

Table 81, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Partridge C. (62-2020)	1	2.2	Unconfined, very low gradient - Slough-like. All pool/glide habitat.	5	0.4	F	(SP)	C	May be utilized by some species for rearing - over-grown and slough-like.
	2	14.3	Broad valley, low gradient. 70% pool/glide.	4	1.0	fGl	Ø (SP)	C	Gradient and habitat appear suitable, but no fish caught - much is overgrown with willow.
	3	6.7	Confined channel, moderate gradient. 70% riffle.	4	2.6	gL	(Ø)	D	Suspect no fish present - marginal habitat.
	4 Ts	1.3	Lower gradient, less confined. 60% riffle.	3	1.9	fGL	(Ø)	D	Suspect no fish present.
McQuesten R. (62-2110)	1	15.6	Large system, broad valley, meandering. 50% pool/glide.	80	0.1	GL	AG, BB, CCG, CH, LSU, NP, RW	A	Confirmed CH spawning and rearing.
	2	83.2	Large system, meandering. 70% pool/glide.	75	0.1	GL	AG, CCG, CH, BB, RW, LSU	A	Confirmed CH spawning and rearing.
Vancouver C. (62-2110-100)	1	1.7	Fluvial fan area, fairly low gradient, meandering 50% pool/glide.	17	(1.3)	GL	AG, CCG, CH	B	CH rearing - very large numbers observed in fish sampling. No CH spawning documented, but substrate and flows may be suitable.
	2	6.0	Frequently confined channel, sinuous pattern 70% riffle.	10	1.0	gL	AG (CCG)	C	AG present - habitat is fair.
	3	2.5	Frequently confined, moderate gradient. 80% riffle.	10	2.3	gL	AG (CCG)	C	AG present - abundance appears low. Mainly riffle habitat.
	4	6.5	Confined, steep gradient 95% riffle.	8	4	gL	AG	D	AG present - abundance appears low. Steep gradient mainly riffle habitat.
	5 Ts	3.7	Confined, very steep gradient. All riffle habitat.	5	7	L	(Ø)	D	Probably too steep for fish.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Thoroughfare C. (62-2110-100-010)	1	1.1	Confined. Approximately 80% riffle.	3	1.2	gL	AG	C	AG present, although habitat appears marginal.
	2	2.7	Moderate confinement, sinuous pattern. 60% riffle	4	2.0	GL	AG	C	AG present - habitat is fair.
	3	7.5	Confined, steep gradient 60% shallow riffle.	3	4	gL	(AG)	D	All habitats are very shallow.
	4 Ts	2.0	Confined, steep gradient. Very small stream.	1	7	gL	(Ø)	D	Very small headwater area.
Right Hook C. (62-2110-100-020)	1	13.1	Frequently confined, sinuous pattern. 65% riffle.	7	(2.5)	gL	AG	C	AG present - habitat fair.
	2 Ts	2.5	Confined, steep gradient. All high velocity riffle.	4	8	gL	(AG)	D	Steep gradient, all shallow riffle.
Unnamed C. (62-2110-100-030)	1 Ts	5.9	Confined, steep gradient. 90% high velocity riffle.	5	6	gL	(Ø)	D	Suspect no fish present due to steep gradient.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Bear C. (62-2110-250)	1	1.2	Very low gradient. Connected with side channel of McQuesten R. All glide habitat.	15	0	F	AG (CCG, CH)	B	Probable CH rearing area.
	2	8.6	Unconfined, low gradient meandering. 90% pool/glide.	7	0.5	Fg	AG, CCG (CH)	B	CH probably rear in lower portion of reach - AG habitat is fair.
	3	9.1	Broad valley, low gradient, meandering. Numerous beaver dams. 60% pool/glide.	5	0.9	FG	CCG (AG)	C	Habitat appears suitable. No AG caught. May be passage problems due to beaver dams.
	4 Ts	4.9	Broad valley, moderate gradient. 50% pool/glide.	4	1.3	fG	(SP)	C	Habitat looks suitable. May be no AG present due to passage problems.
Unnamed C. (62-2110-250-050)	1 Ts	6.5	Broad valley, low gradient, extensive beaver dams. All pool/glide habitat.	3	1.0	F	(SP)	D	Very low gradient, slough-like - may be difficult passage due to beaver dams.
Forty Mile C. (62-2110-260)	1	3.4	Fluvial fan area, broad valley, meandering.	14	1.9	GL	AG (CH)	B	No CH found and very few AG. Physical habitat appears good. Debris jam near mouth may impede passage.
	2	18.5	Confined channel, moderate gradient. Mainly high velocity riffle habitat.	12	2.3	gL	Ø	D	Mainly high velocity riffle.
	3	2.5	Frequently confined, steep gradient. Mainly riffle habitat.	4	3.4	GL	(Ø)	D	Steep gradient riffle habitat.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Forty Mile C. (62-2110-260)	4	5.4	Small, steep gradient, headwater area.	2	5	gL	(Ø)	D	Small, steep gradient.
Unnamed C. (62-2110-260-150)	1	2.3	Small, steep gradient, headwater area.	3	7	gL	(Ø)	D	Small, steep gradient.
	2	3.0	Small, steep gradient, headwater area.	2	5	GL	(Ø)	D	Small, steep gradient. All riffle.
	3	0.6	Small, steep gradient, headwater area.	2	10	gL	(Ø)	D	Small, steep gradient. All riffle.
Boulder C. (62-2110-370)	1	0.9	Fluvial fan area, broad valley, meandering. Mainly riffle habitat.	12	2.2	GL	CH, CCG, (AG)	B	CH captured in fish sample, but appear few in number - habitat is only fair.
	2	1.6	Upper fan area, moderate gradient. Mainly riffle habitat.	10	3.3	gL	(SP)	D	Fairly steep gradient, mainly riffle habitat.
	3	8.1	Confined channel, steep gradient. All high velocity riffle habitat.	5	6	gL	(Ø)	D	Steep gradient riffle.
	4	3.0	Small, steep gradient, headwater area.	1	9	gL	(Ø)	D	Small, steep gradient.
Sunshine C. (62-2110-400)	1	1.3	Fluvial fan area, moderate gradient.	5	4	GL	AG, CCG, CH	B	CH rearing - at least in lower part of reach.
	2	6.4	Confined channel, steep gradient. Mainly riffle habitat.	3	10	gL	(Ø)	D	Steep gradient, mainly riffle.
	3	3.1	Moderately confined, steep gradient. 100% riffle habitat.	2	7	GL	(Ø)	D	Steep gradient, all riffle habitat.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Johnson C. (62-2110-410)	1	4.1	Low gradient, fluvial fan area. Numerous distributaries. Channel difficult to identify.	7	0.8	fG	AG (CH)	(B)	Suspect Ch rear in lower section. Habitat is fairly poor, however, due to instability. Subject to suspended sediment from U/S placer work.
	2	1.8	Moderately confined, mainly riffle habitat (90%).	7	2.0	GL	AG	C	AG present, but habitat is only fair. Subject to suspended sediment from U/S placer work.
	3	2.1	Frequently confined, moderate gradient. Extensively altered channel - 100% riffle.	6	3.3	GL	(AG)	D	AG suspected, but habitat is marginal. Subject to suspended sediment from U/S placer work.
	4	2.4	Confined, steep gradient. 100% riffle.	5	4	GL	(Ø)	D	Habitat very limited.
	5	1.9	Confined, very steep gradient.	4	9	GL	(Ø)	D	Very steep gradient.
	6	1.6	Confined, very steep gradient. Tumbling flow.	3	8	gL	(Ø)	D	Very steep gradient.
	7	1.7	Small, headwater area.	2	9	Gl	(Ø)	D	Small, steep gradient.
	8	1.2	Small, headwater area.	1	15	-	(Ø)	D	Small, steep gradient.
Sabbath C. (62-2110-410-080)	1	3.2	Frequently confined, steep gradient. Tumbling flow.	4	8	gL	(Ø)	D	Steep gradient, limited habitat.
	2	3.1	Small, headwater area.	2	12	GL	(Ø)	D	Small, steep gradient.

Table 81, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Relative Fisheries Value	Rationale and Comments
Unnamed C. (62-2110-410-120)	1	2.1	Steep gradient, 80% riffle habitat.	4	9	GL	(Ø)	D	Steep gradient, limited habitat.
	2	1.6	Steep gradient, 100% riffle habitat.	1	16	Gl	(Ø)	D	Steep gradient, headwater area.
North McQuesten R. (62-2110-470)	1	29.9	Large system, fairly low gradient, irregular meanders, 70% pool/glide habitat.	40	0.2	GL	AG, CCG, CH, LSU, RW	A	CH spawning reported - no CH captured in samples. Habitat appears excellent for AG.
	2	15.6	Large system, fairly low gradient, irregular pattern, 60% pool/glide habitat.	35	0.2	GL	(AG, CCG, CH, LSU, RW)	(A)	CH spawning is suspected but not confirmed.
	3 Ts	15.3	Large system, fairly low gradient, meandering 80% pool/glide habitat.	35	0.3	GL	(AG, CCG, LSU, RW)	C	No information on CH presence. May be upgraded to "A" if CH are found.
Sprague C. (62-2110-470-060)	1	7.6	Broad valley, meandering moderate gradient, 70% pool/glide habitat.	11	1.4	GL	AG	C	AG habitat appears good - no CH fry were found.
	2	2.9	Frequently confined, moderate gradient, 70% riffle habitat.	8	1.9	GL	AG	C	AG habitat is fair.
	3	2.1	Occasionally confined, meandering, moderate gradient. 80% riffle.	5	1.4	gL	AG	C	AG habitat is fair.

Table B1, Continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Sprague C. (62-2110-470-060)	4	3.4	Moderately confined, moderate gradient. 80% riffle.	5	2.0	GL	AG	C	Habitat appears only fair, but AG found in significant numbers.
	5	6.5	Broad valley, moderate gradient with beaver dams. 70% pool/glide.	4	1.8	G	(AG)	C	AG habitat appears good.
	6 Ts	1.2	Headwater area. No distinct channel.	1	3.1	-	(ø)	D	Small, marginal habitat.
Unnamed C. (62-2110-470-060-020)	1	2.8	Frequently confined, moderate gradient. 90% riffle.	6	1.4	GL	(SP)	D	Gradient suitable, but habitat is very limited.
	2	4.6	Frequently confined, moderate gradient. 90% riffle.	3	4	GL	(ø)	D	No fish caught, marginal habitat.
	3	3.4	Small, headwater area.	2	14	gL	(ø)	D	Small, steep gradient.
Unnamed C. (62-2110-470-060-100)	1	2.8	Moderately confined, moderate gradient. Mainly riffle.	4	2.7	Gl	(SP)	C	AG habitat fair, large numbers found in similar habitat in system.
	2	3.2	Small, fairly steep gradient.	2	3.8	GL	(ø)	D	Small, steep gradient.
Unnamed C. (62-2110-470-060-140)	1	4.9	Frequently confined, moderate gradient. All riffle habitat.	4	2.9	gL	(ø)	D	AG habitat appears marginal.
	2	3.6	Frequently confined, steep gradient, all riffle habitat.	3	7	gL	(ø)	D	Small, steep gradient.
Gem C. (62-2110-470-060-220)	1	2.9	Lower part of reach extensively altered - upper part steep. All riffle habitat.	4	7	GL	(ø)	D	Steep gradient, marginal habitat.

Table 81, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Ballard C. (62-2110-470-070)	1	1.3	Low gradient, meandering fluvial fan area.	15	0.2	Gl	AG	C	AG habitat appears good, No CH fry captured.
	2	6.5	Frequently confined, moderate gradient, meandering. 70% riffle.	12	1.7	gL	AG	C	AG present, habitat is fair.
	3	3.9	Confined channel, moderate gradient. 80% riffle.	10	1.7	gL	AG	C	AG present, habitat is fair.
	4	4.6	Frequently confined, moderate gradient. 70% riffle.	5	2.5	gL	AG	C	AG present in numbers, although habitat only fair (mainly shallow riffle).
	5	6.0	Frequently confined, steep gradient. 100% riffle habitat.	4	3.8	L	(Ø)	D	Steep, marginal habitat.
	6	2.6	Small, headwater area.	2	6	GL	(Ø)	D	Small, steep gradient.
Red C. (62-2110-470-140)	1	2.0	Low gradient, broad valley, meandering. 70% pool/glide.	14	0.9	fGl	AG	C	AG habitat appears good.
	2	1.9	Frequently confined. Mainly shallow riffle habitat.	13	1.8	GL	AG	C	AG present, but habitat only fair.
	3	9.3	Broad valley, meandering 60% riffle.	12	1.3	GL	AG	C	AG present, habitat is fair.
	4	7.5	Frequently confined, moderate gradient. Mainly riffle habitat.	8	1.9	gL	AG	C	AG present, marginal habitat.
	5	1.4	Broad valley, meandering. 70% riffle.	5	1.8	GL	(AG)	C	AG probably present, habitat is fair.
	6	5.3	Small, headwater area.	2	7	gL	(Ø)	D	Small, steep gradient.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Unnamed C. (62-2110-470-140-220)	1	4.8	Small, headwater area.	1	6	FG	(Ø)	D	Small, steep gradient.
South McQuesten R. (62-2110-480)	1	35.3	Large system, very low gradient, tortuous meanders with oxbows. Mainly pool/glide habitat.	25	0.1	fG	AG,BB,CCG,NP, RW(CH,LSU)	(A)	CH reported present, but none were captured or observed. Flows and substrate do not appear suitable for CH spawning.
	2	50.3	Large system, very low gradient, meandering. 80% pool/glide.	20	0.1	FGl	AG,BB,CCG,NP, RW(CH,LSU)	(A)	CH reported present, but none were captured or observed. Flows and substrate do not appear suitable for CH spawning.
	3	4.1	Frequently confined, low gradient. 70% pool/glide.	15	0.3	fgL	(AG,CCG,LSU, NP,BB,RW)	C	Good AG habitat.
	4	1.7	Entrenched, canyon-like reach. Mainly high velocity riffle habitat.	15	0.5	gL	(AG,CCG,BB,RW)	C	AG present, habitat is marginal.
	5	1.6	Frequently confined, low gradient. 70% pool/glide.	15	0.2	fGL	(AG,CCG,LSU, NP,BB,RW)	C	AG habitat appears good.
	6	5.8	Very low gradient, meandering with oxbows. 90% pool/glide.	15	0.1	FG	(AG,CCG,LSU, LW,NP,LT,BB,RW	(B)	Low gradient area below lake - may be utilized by lake populations for spawning and/or rearing. Sub-strates not suitable for LT spawning.
	7	13.0	McQuesten Lake.	-	-	-	AG,LT,LW,NP, (CCG,LSU,BB,RW	A	Lake with Schedule I fish (LT).
	8	5.9	Very low gradient, fine substrate. 80% pool/glide habitat.	10	0.2	Fg	(AG,CCG,LSU,NP, WF,LT,BB,RW)	(B)	Low gradient area above lake - may be utilized by lake populations for spawning and/or rearing. Sub-strates not suitable for LT spawning.
	9	2.8	Frequently confined, moderate gradient. 70% riffle.	8	1.4	GL	(AG, CCG)	C	AG suspected - habitat is fair.
	10	1.7	Entrenched channel, mod-erate gradient. Shallow riffle.	8	3.4	gL	(SP)	D	AG habitat - appears poor.
	11 Ts	4.6	Confined, steep gradient. All riffle habitat.	6	6	gL	(SP)	D	AG habitat appears poor.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Seattle C. (62-2110-480-070)	1	3.0	Broad valley, fluvial fan area. 80% pool/glide.	7	1.6	Gl	(AG)	C	AG suspected, habitat appears fair. Subject to suspended sediment from U/S placer work.
	2	3.3	Frequently confined, moderate gradient. 60% riffle.	6	1.8	GL	(SP)	C	AG suspected, marginal habitat. Subject to suspended sediment from U/S placer work.
	3	2.7	Frequently confined, moderate gradient. 100% riffle habitat.	6	2.0	gL	(Ø)	D	Habitat very limited, suspect no fish use.
	4	1.8	Confined channel, extensively altered by placer work.	5	1.6	GL	(Ø)	D	Habitat very limited, suspect no fish use.
	5 Ts	2.0	Confined, steep gradient.	3	4	GL	(Ø)	D	Small, steep gradient.
Morrison C. (62-2110-480-070-080)	1	4.1	Confined, steep gradient, canyon-like. Some alteration from placer work.	4	5	gL	(Ø)	D	Small, steep gradient, no suitable fish habitat.
	2	0.9	Small, steep gradient. 90% riffle habitat.	3	4	GL	(Ø)	D	Small, steep gradient.
	3	3.5	Small headwater area.	2	7	gL	(Ø)	D	Small, steep gradient.
Unnamed C. (62-2110-480-070-080-080)	1	4.1	Small headwater area. Some placer work.	2	9	GL	(Ø)	D	Small, steep gradient.

Table 31, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Haggart C. (62-2110-480-180)	1	5.5	Broad valley, low gradient, meandering. 70% pool/glide.	12	0.4	fGl	AG, CCG,BB, RW	C	AG habitat appears good. Subject to suspended sediment from U/S placer work.
	2	15.9	Moderately confined, low gradient, meandering. 50% pool/glide.	15	0.6	GL	AG, CCG,BB, RW	C	AG habitat fairly good. Subject to suspended sediment from U/S placer work.
	3	4.6	Extensively altered by placer work. Difficult upstream migration.	10	1.4	gL	AG	D	Virtually no habitat exists due to alterations.
	4	1.5	Frequently confined, moderate gradient. 70% riffle.	10	1.8	gL	AG	C	Fair AG habitat exists - few fish present due to difficult passage downstream.
	5	4.9	Frequently confined, moderate gradient. 80% riffle.	7	2.1	gL	(AG)	D	AG habitat is marginal.
	6 Ts	3.0	Confined channel, steep gradient. 90% riffle habitat.	4	3.6	gL	(Ø)	D	AG habitat is poor.

Table B1. ntinued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Swede C. (62-2110-480-180-060)	1	1.8	Frequently confined, moderate gradient, some channel alterations. 75% shallow riffle.	5	1.8	fGL	AG	D	AG habitat is marginal - mainly shallow riffle. Few fish present - culvert at mouth may form barrier.
	2 Ts	4.4	Small, frequently confined, moderate gradient 55% pool/glide.	3	2.4	fGl	(AG)	D	Small stream, mainly shallow.
Lynx C. (62-2110-480-180-160)	1	13.9	Broad valley, low gradient, meandering. 70% pool/glide.	7	0.8	GL	AG,CCG,BB,RW	C	Very good AG habitat - large numbers present.
	2	4.4	Moderately confined, low gradient, meandering. Some beaver dams. 60% pool/glide.	4	0.9	GL	(AG)	C	AG habitat appears fairly good.
	3 Ts	1.6	Broad valley, open meadow area with beaver dams.	4	1.2	FGl	(AG)	C	Habitat appears marginal - mainly overgrown and slough-like.
Moose C. (62-2550)	1	3.3	Broad valley, low gradient, meandering. 70% pool/glide.	10	0.5	fGL	AG, CCG, CH	B	CH rearing area.
	2 Ts	7.5	Broad valley, very low gradient, meandering. All pool/glide habitat.	8	0.2	FG	(AG)	C	AG suspected, habitat is fair.

Table B1 ...ntinued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Mayo R. (62-3850)	1	6.3	Large system, moderately confined, fairly low gradient. 70% riffle.	60	0.4	FGL	AG, BB, CCG, CH, LSU, LW, RW,NP,IN,LKC	A	Probable CH spawning area.
	2	4.5	Entrenched, moderate gradient. 90% riffle.	25	1.2	gL	AG, CH, CCG, LSU . NP	A	CH spawning observed.
	3	6.2	Wareham Lake (Reservoir)	-	-	-	AG,BB,CCG,LSU, NP,WF,LT)	C	Resevoir has little fisheries potential at present, due to snags and drawdown.
	4	2.0	Short reach subject to intermittent flooding and drawdown.	-	-	-	(AG, BB, CCG, LSU, NP, WF)	C	Flowing section subject to flooding.
	5	35.1	Large system, moderately confined, low gradient, meandering. 55% riffle.	40	0.2	fGL	AG, BB, CCG, LSU, NP, RW	C	AG habitat is fair. Large system probably provides over-wintering area. Subject to suspended sediment from U/S placer work.
	6	1.9	Entrenched, fairly low gradient. 70% pool/ glide.	40	0.8	fgL	AG BB, CCG, LSU, NP, RW	C	AG habitat appears good. Warmer water below dam may provide over-wintering area.
	7	38.5	Mayo Lake	-	-	-	AG, BB, CS, IN, LT, NP, WF	A	Lake with schedule I fish.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Minto C. (62-3850-060)	1	10.6	Frequently confined, low gradient, meandering. 70% pool/glide.	10	0.9	FGL	AG, CCG (BB, LSU, NP, WF)	C	Good AG habitat. Subject to suspended sediment from U/S placer work.
	2	3.9	Frequently confined, fairly low gradient. 50% pool/glide.	8	(0.4)	fgL	AG, CCG (BB, LSU, LT, NP, WF)	C	AG habitat appears fairly good. Subject to suspended sediment from U/S placer work.
	3	5.7	Broad valley, low gradient, low velocity with beaver dams. 100% pool/glide.	6	0.3	Fg	AG, CCG, (BB, LSU, LT, NP, WF)	(B)	AG habitat fairly good - significant numbers captured in sampling. May be utilized by lake populations for spawning and/or rearing. Substrate and flows not suitable for LT spawning.
	4	4.2	Minto Lake	-	-	-	AG, BB, CCG, LSU, LT, LW, NP	A	Lake with Schedule I fish.
Bennett C. (62-3850-060-110)	1	1.9	Moderately confined, moderate gradient. 75% riffle.	4	2.8	GL	AG, CCG	C	AG habitat is only fair - substrate appears suitable for spawning.
	2	4.7	Confined channel, steep gradient. 80% riffle.	3	5	gL	(Ø)	D	Steep gradient, very limited habitat.
	3 Ts	0.7	Confined channel, steep gradient. 60% riffle.	3	6	gL	(Ø)	D	Small, steep gradient.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Highet C. (62-3850-060-120)	1	2.7	Moderately confined, moderate gradient. 70% riffle. Upper portion altered by placer work.	4	2.0	fgL	AG, BB, CCG	C	AG habitat only fair - substrate suitable for spawning in places. Subject to suspended sediment from U/S placer work.
	2	2.5	Confined, moderate gradient. All riffle habitat.	4	2.8	gL	(AG, CCG)	D	Designated above 2500 ft - marginal habitat.
	3	5.3	Extensively altered channel. Moderate gradient. All shallow riffle.	5	4	gL	(Ø)	D	Designated stream - poor habitat due to gradient and alterations. Several impassable barriers (culverts, settling ponds, etc.) present.
	4	2.7	Small headwater area.	2	12	gL	(Ø)	D	Designated stream - small, steep gradient.
Carlson C. (62-3850-060-220)	1	2.3	Broad valley, unconfined channel, low gradient. 100% pool/glide.	4	0.3	FG	(SP)	C	Habitat is very low gradient - may be utilized by lake species for rearing and/or spawning. Substrate not suitable for LT spawning. Subject to suspended sediment from U/S placer work.
	2	4.2	Frequently confined, 50% pool/glide.	3	1.1	FGL	(SP)	C	Small stream, high percentage of fines, overgrown with willow - habitat appears marginal. Subject to suspended sediment from U/S placer work.
	3	3.1	Broad valley, moderate gradient. Some alterations at top end. 80% glide.	3	1.9	FG	(SP)	C	Small stream - habitat appears marginal. Subject to suspended sediment from U/S placer work.
	4	2.3	Confined valley, steep gradient. Extensively altered - no fish passage.	3	6	gL	(Ø)	D	Steep gradient, extensive channel alterations.
	5 Ts	1.1	Small, headwater area.	2	10	gL	(Ø)	D	Small, steep gradient.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
McLagan C. (62-3850-060-230)	1	1.4	Broad valley, unconfined. Mainly low gradient. 50% pool/glide.	4	(2.8)	fGl	(SP)	C	Habitat is mainly very shallow, but may be utilized for rearing or spawning by lake populations (esp. AG). Substrate is unsuitable for LT spawning.
	2	1.0	Confined channel, steep gradient. Extensively altered.	4	6	gL	(Ø)	D	Steep gradient, extensively altered.
	3	3.6	Entrenched channel, steep gradient, broken flow.	3	9	L	(Ø)	D	Steep gradient.
	4 Ts	0.6	Confined, steep gradient, mainly riffle habitat.	3	5	gL	(Ø)	D	Steep gradient, limited habitat.
Duncan C. (62-3850-280)	1	2.1	Fluvial fan area, low gradient, meandering. 60% riffle.	12	0.7	FGl	AG, CCG (BB, RW)	C	AG habitat fairly good - quite large numbers captured in samples. Subject to suspended sediment from U/S placer work.
	2	5.4	Frequently confined, moderate gradient. 80% riffle habitat. Extensively altered.	12	1.7	fGl	AG(CCG)	C	AG habitat is fairly limited. Subject to suspended sediment from placer work.
	3	3.1	Extensively altered channel. Channel mainly straight, wide, and shallow.	10	1.3	fGl	AG(CCG)	C	AG habitat is currently poor due to channel alterations but enhancement potential exists. Subject to suspended sediment from placer work.
	4	8.0	Frequently confined, moderate gradient. 40% pool/glide.	12	1.1	fGL	AG(CCG)	C	AG habitat appears good - channel alterations much less extensive. Subject to suspended sediment from U/S placer work.
	5	1.2	Entrenched canyon. High gradient with impassable falls.	10	5	gL	(AG, CCG)	D	Steep gradient, poor habitat.
	6	1.0	Extensively altered. Much of the reach is channelized.	11	3	GL	(Ø)	D	No fish due to falls downstream.
	7	1.8	Confined channel, steep gradient. Mainly riffle habitat.	6	4	gL	(Ø)	D	No fish due to falls downstream.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Duncan C. (62-3850-280)	8	2.9	Low gradient meadow area with beaver dams. 40% pool/glide.	6	1.8	fGl	(Ø)	D	No fish due to falls downstream.
	9 Ts	2.5	Small, steep gradient headwater area. 80% riffle.	3	7	gL	(Ø)	D	No fish due to falls downstream.
Williams C. (62-3850-280-020)	1 Ts	3.9	Very small system, moderate gradient. 60% pool/glide.	3	2.8	gL	Ø	C	Very small system, habitat appears fair, but no fish caught.
Parent C. (62-3850-280-030)	1	0.6	Entrenched, steep gradient. 100% riffle.	6	4	gL	(AG)	D	Steep gradient, poor habitat.
	2	1.8	Confined, steep gradient some alterations. 90% riffle.	8	6	gL	(AG)	D	Steep gradient, habitat appears poor.
	3	3.8	Confined, steep gradient. 90% riffle.	5	6	gL	(AG)	D	Steep gradient, poor habitat.
	4 Ts	1.9	Small headwater area.	3	18	gL	(Ø)	D	Small, very steep gradient.
Lightning C. (62-3850-280-150)	1	1.7	Frequently confined, moderate gradient. 75% riffle.	8	(0.4)	GL	AG (CCG)	C	AG present, but habitat is poor.
	2	1.2	Entrenched, Canyon area. 100% riffle.	8	2.5	gL	AG	D	AG present, but habitat poor.
	3	3.0	Confined, moderate gradient. 90% riffle.	7	2.8	gL	AG	C	AG present, but habitat is only marginal.
	4	2.7	Confined, moderate gradient. 80% riffle.	5	2.8	gL	(AG)	C	Suspect AG present, but habitat is only marginal.
	5	2.7	Small, moderate gradient 65% riffle.	3	3.5	fgL	(AG)	D	Small, marginal habitat.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
McMillan Gulch (62-3850-280-150-060)	1 Ts	2.1	Small, moderate gradient. 65% riffle.	3	3.6	fgL	(AG)	D	Small, marginal habitat.
Davidson C. (62-3850-300)	1	3.1	Fluvial fan area, fairly low gradient. 60% pool/glide.	10	1.2	fGl	AG	C	AG habitat appears good but no AG captured in fish sample.
	2	6.0	Partially entrenched, canyon-like reach. Moderate gradient. 80% riffle.	8	2.9	gL	AG	C	AG habitat is fair. AG abundance appears low.
	3	4.7	Fairly broad valley, low gradient, meandering. Some beaver dams. 60% pool/glide.	7	0.5	fGl	Ø	C	AG habitat appears good, but no AG caught in samples.
	4	1.9	Entrenched, steep gradient. 70% riffle.	4	6	gL	(Ø)	D	Steep gradient, suspect no fish.
	5 Ts	2.3	Frequently confined, moderate gradient, meadow area. Mainly riffle.	3	2.1	FGL	(Ø)	D	Small, very little flow - suspect no fish.

Table 3i, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Keystone C. (62-3850-420)	1	1.1	Fluvial fan area. Moderate gradient. 100% riffle.	5	(4)	gL	AG (CCG)	C	AG present - habitat is generally poor. Lake populations may utilize reach for limited spawning and rearing.
	2	2.4	Confined, steep gradient. 90% riffle.	5	6	gL	(AG)	D	Steep gradient, marginal habitat. Suspect AG only in lower part of reach.
	3	2.4	Confined, moderate gradient. 60% riffle.	5	3.6	gL	Ø	D	AG habitat is marginal - no fish caught in sample.
	4 Ts	3.3	Confined, steep gradient. 90% riffle.	4	8	gL	(Ø)	D	Steep gradient, poor habitat.
Anderson C. (62-3850-510)	1	0.7	Fluvial fan area with extensive alterations. 95% riffle. Channel diverted near mouth.	6	3.7	GL	Ø	D	AG habitat is poor - appears to be no access for fish due to channel alterations.
	2	2.6	Steep gradient, some alterations. Virtually all riffle habitat.	5	8	gL	(Ø)	D	Steep gradient, poor habitat.
	3	2.8	Small, steep gradient, headwater area.	3	11	GL	(Ø)	D	Too steep for fish utilization.
Unnamed C. (62-3850-510-020)	1	1.3	Small, headwater area.	2	22	GL	(Ø)	D	Too steep for fish utilization.

Table 3., continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Cascade C. (62-3850-590)	1	0.3	Fluvial fan area, steep gradient. 100% riffle. Considerably altered by placer operation.	4	9	GL	CCG	D	Gradient is too steep for fish utilization.
	2	2.6	Confined, steep gradient. 90% riffle.	4	9	gL	(Ø)	D	Steep gradient.
	3	2.5	Moderately confined. 80% pool/glide.	2	5	fGl	(Ø)	D	Small, fairly steep - suspect no fish present.
	4	0.5	Very small, shallow lake	-	-	-	(Ø)	D	Suspect no fish present.
Ledge C. (62-3850-640)	1	1.4	Fluvial fan area, steep gradient. 100% riffle.	7	13	gL	Ø	(C)	Steep gradient, poor habitat - extreme lower end may be utilized for spawning by AG. No fish caught in sample.
	2	1.7	Confined, steep gradient. All riffle habitat.	5	10	gL	(Ø)	D	Too steep for fish utilization.
	3	2.6	Small, headwater area.	2	18	gL	(Ø)	D	Too steep for fish utilization.

Table 81, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recommended Reach Class	Rationale and Comments
Granite C. (62-3850-880-050)	1	2.8	Broad valley, low gradient. Channel is connected with small kettle lakes.	8	0.4	fG	AG	C	AG habitat appears very good, but no fish were caught in July sample.
	2	4.9	Entrenched, canyon-like reach with cascades. 90% steep riffle.	8	5	gL	(AG)	D	Steep gradient - marginal habitat. Suspect AG only in lower part of reach. Cascades appear to be a barrier to AG.
	3	2.9	Confined, moderate gradient. 85% riffle.	8	2.2	gL	(Ø)	D	AG habitat is marginal - suspect no fish present.
	4	7.6	Frequently confined, moderate gradient. 70% riffle.	7	1.8	gL	(Ø)	D	AG habitat is fair, but appears to be no fish present.
	5	2.7	Low gradient open meadow with beaver dams. 70% pool/glide.	6	(2.5)	fGl	(Ø)	D	AG habitat appears good, but suspect no fish present.
	6	1.8	Confined, steep gradient. 90% shallow riffle.	5	7	gL	(Ø)	D	Steep - suspect no fish present.
	7	2.9	Small, headwater area.	4	11	GL	(Ø)	D	Steep - suspect no fish present.

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Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Relative Fisheries Value	Rationale and Comments
Davenport C. (69-9100-310)	1	0.9	Unconfined fluvial fan area with distributaries. No distinct channels. Low gradient.	4	1.7	gL	(sp)	Low	Generally poor habitat due to channel instability, but may be limited utilization by Gladys Lake species.
	2	1.0	Confined, steep gradient. Debris dams form possible barriers. 80% broken riffle.	3	11	L	(Ø)	Nil	Too steep for fish utilization.
	3	2.3	Frequently confined, steep gradient. 90% riffle.	3	9	gL	(Ø)	Nil	Too steep for fish utilization.
	4	1.4	Entrenched, canyon reach. 90% broken riffle.	3	9	gL	(Ø)	Nil	Too steep for fish utilization.
	5	1.2	Frequently confined, moderate gradient. Mainly riffle habitat.	4	1.8	gL	(Ø)	Nil	Habitat is fair, but suspect no fish present.
	6	0.5	Small, shallow lake.	-	0	-	(Ø)	Nil	Probably too shallow to provide overwintering - suspect no fish present.
Consolation C. (67-9100-320)	1	1.8	Fluvial fan area with distributaries. Some beaver dams. Low gradient.	9	0.9	fGL	CCG (sp)	(Moderate)	Habitat appears suitable for spawning and rearing of lake species (especially AG), however only CCG captured in fish samples.
	2	2.8	Entrenched reach, moderate gradient, slightly altered by placer work. Debris dams may impede passage. 90% riffle.	7	3.8	gL	(CCG)	Low	Fairly steep gradient, mainly riffle. CCG was only species captured in system.
	3	3.6	Moderately confined, low gradient, some beaver dams. 50% pool/glide.	7	0.8	gL	(CCG)	(Moderate)	AG habitat appears good, but only CCG captured

Table 11. Continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Relative Fisheries Value	Rationale and Comments
Consolation C. (67-9100-320)	4	1.3	Short confined section, moderate gradient. 75% riffle.	6	1.2	gL	(CCG)	Low	AG habitat is fair, but only CCG captured.
	5	5.6	Broad valley, meandering, low gradient. Some beaver dams. 70% pool/glide.	8	0.8	GL	(CCG)	(Moderate)	AG habitat appears excellent, but only CCG captured in fish samples.
	6	2.7	Confined, moderate gradient. 90% high velocity riffle.	5	3.4	gL	(CCG)	Low	AG habitat marginal.
	7	2.9	Frequently confined, moderate gradient, open subalpine. 80% shallow riffle.	5	2.1	L	(Ø)	Low	Habitat marginal, suspect no fish.
	8 Ts	1.4	Subalpine area. Wide shallow riffle.	6	6	gL	(Ø)	Low	Habitat marginal, suspect no fish.
O'Donnel R. (69-9900-310)	1	7.0	Broad valley, low gradient, meandering. 80% pool/glide habitat.	20	0.4	Gl	AG, CCG (WF)	High	Good AG habitat. Probably utilized by other Atlin Lake species.
	2	5.1	Entrenched, mainly high velocity riffle habitat.	20	0.9	GL	AG	Low-Moderate	Few pools or glides. AG habitat only fair. Probably important migration reach between fish overwintering in Atlin Lake and upper reaches.
	3	2.8	Wide valley, fairly low gradient, meandering. 70% pool/glide habitat.	15	0.9	GL	AG	High	Good AG habitat. May be some overwintering areas.
	4	4.4	Frequently confined, low gradient. 60% riffle.	14	0.7	GL	AG	Moderate	AG habitat is fair. May provide some over-wintering area.
	5	7.3	Entrenched, mainly high velocity riffle.	13	0.8	gL	AG	Low-Moderate	AG habitat marginal, but may provide some overwintering area.

Table 8.. Continued

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Relative Fisheries Value	Rationale and Comments
O'Donnel R. (69-9900-310)	6	5.1	Wide valley, frequently confined, low gradient, meandering	12	0.6	Gl	AG	High	Good AG habitat.
	7	3.0	Moderately confined. 60% pool/glide.	12	1.7	GL	AG	Moderate-High	Fairly good AG habitat.
	8	17.5	Wide valley, low gradient. 70% pool/glide.	12	0.9	GL	AG, CCG	High	Good AG habitat, few deep pools may provide overwintering habitat.
	9	5.8	Wide valley, meandering low gradient. 70% pool/glide.	8	0.4	Gl	(AG)	Moderate-High	Good AG habitat, small section of reach altered by placer operation.
	10	4.4	Wide valley, meandering moderate velocity.	6	(5)	GL	AG	Moderate	Habitat fair for AG, limited pools (10%)
	11	2.2	Steep gradient, 60% riffle habitat, no pools, high velocity.	2	6	gL	(Ø)	Low	No pools, limited glide areas, habitat marginal, suspect no fish.
Wilson C. (69-9900-310-020)	1	4.5	Moderate gradient, entrenched, high velocity	12	2.4	gL	(Ø)	Nil	Limited habitat, however series of small falls and chutes appears to be impassible, no fish were captured at two sites in this system.
	2	8.5	Wide valley, meandering. 60% pool/glide.	7	1.7	GL	(Ø)	Nil	Habitat available, no fish in system.
	3	7.3	Narrow valley, moderate gradient, high velocity, limited habitat.	3	2.3	GL	(Ø)	Nil	Habitat available, no fish in system.
	4	1.8	Wide valley, unconfined, low gradient. Small stream, little habitat available.	1	0.8	Gl	(Ø)	Nil	Little habitat, no fish in system.
	5	0.5	Small shallow lake.	-	0	-	(Ø)	Nil	No fish captured or observed in system.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Burdette C. (69-9900-310-020)	1	1.4	Steep gradient, high velocity. Mainly riffle habitat.	4	4	GL	(Ø)	Nil	Limited habitat, no fish in system.
	2	2.6	Steep gradient, high velocity, confined. Mainly riffle habitat.	3	6	gL	(Ø)	Nil	Limited habitat, no fish in system, placer operation in this reach.
	3 Ts	2.1	Steep gradient, high velocity, wide valley. Mainly riffle habitat.	2	5	GL	(Ø)	Nil	Poor habitat, no fish in system.
Unnamed C. (69-9900-310-020-220)	1	3.3	Steep gradient, high velocity, wide valley. Riffle habitat.	1	6	Gl	(Ø)	Nil	Poor habitat, no fish in system.
Canyon C. (69-9900-310-110)	1	0.5	Steep gradient, high velocity, no pools.	3	5	GL	(Sp)	Low	Limited habitat, if fish present probably in low numbers, alteration of reach due to placer operation.
	2	3.3	Steep gradient , wide valley. Some pool/glide habitat.	3	5	G	(Ø)	Nil	Limited habitat, small falls and canyons present, suspect no fish in this reach.
	3 Ts	1.8	Moderate gradient, no pools, meandering.	1	1.5	Gl	(Ø)	Nil	Limited habitat, suspect no fish.
Mahar C. (69-9900-310-150)	1	0.9	Wide valley, meandering. Approx. 50% pool/glide.	5	(4)	Gl	CCG (AG)	L - M	No AG were captured but habitat may be suitable for AG spawning.
	2	1.1	Moderate gradient, mainly riffle habitat	3	(1.7)	G	(Ø)	Nil	Limited habitat, suspect no fish.
	3	2.5	Steep gradient, mainly riffle habitat	2	7	GL	(Ø)	Nil	Poor habitat, suspect no fish.
Nancy C. (69-9900-310-230)	1 Ts	2.3	Moderate gradient, no distinct channel, shallow, wide valley	1	2.8	fG	(CCG)	Low	Limited habitat, suspect sculpins only.

Table 81, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recommended Reach Class	Rationale and Comments
Bull C. (69-9900-310-280)	1	2.9	Moderate gradient, meandering, parts of reach altered due to placer operation.	7	1.7	GL	(AG)	Low	Limited habitat. AG captured above. Reach subject to suspended sediments from placer operation in this reach.
	2	2.3	Much of the reach has been altered due to placer mining. Many sections have been channelized.	6	1.5	GL	(AG)	Low	Due to extensive alteration of reach this reach is probably only used for migration as AG were captured upstream. Subject to further alteration and suspended sediments.
	3 Ts	2.7	Moderate gradient mainly glide and riffle habitat, shallow, meandering	3	1.7	GL	CCG	Low	Limited habitat, no AG captured.
Fox C. (69-9900-310-280-030)	1	1.9	Moderate gradient, meandering. Some pool/glide habitat.	5	1.6	GL	AG, CCG	Low-Moderate	Fair habitat available; used for rearing, may be used for limited spawning. Impassible falls at top of this reach.
	2	3.0	Moderate gradient, glide/riffle habitat, wide valley, meandering	2	1.6	GL	(Ø)	Nil	Falls in lower reach will exclude fish in this or upper reaches.
	3	2.2	Irregular pattern, no distinct channel, wide valley, marsh-like.	0.5	(1)	Gl	(Ø)	Nil	Poor habitat - suspect no fish due to falls in lower reach.
Slate C. (69-9900-310-310)	1	2.0	Tortuosly meandering, low gradient. Approx. 60 - 70% pool/glide. Extensive beaver dams.	4	0.8	fG	CCG (AG)	Moderate	Good habitat available - only CCG captured. AG may be excluded due to extensive beaver activity throughout reach.
	2	2.2	Low gradient, meanderin some alteration and diversions from placer	3	0.7	Gl	(Sp)	Low-Moderate	Undisturbed portions provide some habitat. Subject to alteration and suspended sediments from placer operation. Small falls part way through this reach probably impassible.
	3	3.3	Moderate gradient, wide valley, meandering. Approx. 40% pool/glide habitat.	2	2.3	Gl	(Ø)	Nil	Limited habitat - suspect no fish due to barrier downstream.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
McKinley C. (69-9900-310-330)	1	7.4	Moderate gradient, wide valley, meandering. Approx. 40-50% pool/ glide.	4	2.5	GL	(AG)	Low-M	AG habitat appears fair.
	2 Ts	2.6	Small irregular channel, wide valley, shallow. Limited pool/glide habitat.	2	(5)	fGl	(Ø)	Nil	Small stream, limited habitat.
Feather C. (69-9900-310-350)	1	1.8	Wide valley, mainly riffle habitat.	3	(10)	Gl	(SP)	Low	Small stream, limited habitat.
	2	1.0	Wide valley, fast flow-ing, mainly riffle habitat.	1	3	GL	(Ø)	Nil	Small stream, very marginal habitat.

Table B., continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Relative Fisheries Value	Rationale and Comments
Pine C. (69-9900-390)	1	1.3	Fluvial fan area, braided channel. Virtually all shallow riffle.	100	1.2	GL	AG(CCG,WF, BB)	Moderate	Habitat is quite poor due to channel instability but reach may be utilized by species from Atlin Lake. Subject to high suspended sediment loads.
	2	6.2	Generally confined, but with several open, braided areas. Canyon and impassible falls at upper end. 75% high velocity riffle.	30	1.7	gL	AG(CCG)	Low-Moderate	Habitat is marginal - mainly shallow and swift. Subject to high suspended sediment loads.
	3	7.3	Extensively channelized and diverted for placer work. Virtually all high velocity riffle.	15	1.3	gL	AG(CCG)	Low	Habitat is poor due to extensive channelization.
	4	5.8	Low gradient, some beaver dams. Extensive placid areas. 60% pool/glide.	25	0.5	gL	AG(CCG)	High	Very good AG habitat - for both adults and rearing juveniles. Probably a major spawning area for Surprise Lake populations.
	5	25.8	Surprise Lk.			-	AG,CCG	High	Appears to be a large AG population - potential for stocking LT.
	6	2.4	Very low gradient, little confinement. Extensive beaver dams may impede passage. All pool/glide habitat.	6	0.4	FG	CCG(AG)	Moderate	Suspect AG may spawn and rear in accessible areas - no AG caught in samples, but fry observed.
	7	0.6	Short confined section - mainly riffle.	3	4	fGl	(AG,CCG)	Low	Marginal habitat, possibly not accessible due to beaver dams.
	8 TS	3.5	Low gradient, extensive beaver dams. All pool/glide habitat.	2	0.9	Fg	(Ø)	Low	Habitat appears poor - beaver dams may block access.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Recom-mended Reach Class.	Rationale and Comments
Spruce C. (69-9900-390-010)	1	1.7	Moderate gradient, meandering. Approx. 60% pool/glide.	15	1.8	GL	(AG)	Mod	AG habitat appears good. Reach subject to extremely high suspended sediments due to series of placer operations upstream.
	2	7.9	Moderate gradient, extensive alteration due to placer operations.	10	3.3	gL	(Ø)	Nil	Habitat extremely altered and subject to very high suspended sediments from placer operations. Many abstructions due to dams and settling ponds. Suspect no AG present due to falls at lower end of reach.
	3	8.6	Moderate gradient, broad valley, 50-60% pool/ glide.	6	1.5	GL	CCG	Low	Part of reach altered by placer operation - habitat is fair in undisturbed portions. Subject to suspended sediment. Suspect no AG present - Sculpins may have crossed over from O'Donnel drainage.
	4	4.9	Multichanneled, broad valley. 50% pool/glide.	3	0.9	fGl	(SP)	Low	Habitat fair - portions of reach altered by placer operation and subject to suspended sediments. Suspect no AG present.
	5	1.1	Low gradient, broad valley, shallow irregu-lar channel.	1	(1)	fG	(Ø)	Nil	Very small, marginal habitat.
Unnamed C. (69-9900-390-010-060)	1	1.4	Moderate gradient, mainly riffle habitat.	1.5	2.9	GL	(Ø)	Nil	Small stream, marginal habitat.
	2	1.9	Low gradient, shallow, wide valley, meandering	1.5	0.8	fG	(Ø)	Nil	Small stream, marginal habitat.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Relative Fisheries Value	Rationale and Comments
Birch C. (69-9900-390-030)	1	2.2	Fluvial fan area with many distributaries. No distinct channel.	-	0.7	-	(Ø)	Nil	Distributaries are so small that they afford no fish habitat.
	2	3.8	Confined and extensively altered. All shallow riffle.	4	8	gL	(Ø)	Nil	Very extensively altered - suspect no fish present.
	3 Ts	2.8	Confined, steep gradient. All riffle habitat.	4	5	gL	(Ø)	Nil	Poor habitat - suspect no fish.
Otter C. (69-9900-390-050)	1	0.4	Fluvial fan area with distributaries. No riparian vegetation. All riffle habitat.	6	2.6	gL	AG(CCG)	Low-Moderate	Habitat appears poor, but AG present and residents report spawning.
	2	2.4	Confined, no riparian vegetation. All shallow riffle. 2 m falls probably blocks access.	5	4	gL	AG	Low	AG probably present only in lower section. Habitat is poor.
	3	1.1	Frequently confined. 80% riffle habitat.	5	5	gL	(Ø)	Low	Suspect no fish present.
	4 Ts	3.7	Broad valley, very low gradient. Extensive beaver dams. 100% pool/glide.	4	0.7	fGl	(Ø)	Low	Habitat generally poor due to lack of confinement. Suspect no fish present.
Boulder C. (69-9900-390-060)	1	1.1	Fluvial fan area with distributaries. No distinct channel. Extensive alterations in upper section.	-	6	-	(Ø)	Low	Extensive distributaries appear to afford no fish habitat.
	2	3.6	Confined and extensively altered. All shallow riffle.	4	7	gL	(Ø)	Nil	Very extensively altered - suspect no fish present.
	3	1.1	Small, headwater area.	3	14	gL	(Ø)	Nil	Steep gradient - suspect no fish present.

Table B., continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Relative Fisheries Value	Rationale and Comments
Wright C. (69-9900-390-070)	1	0.4	Fluvial fan area with distributaries. All riffle habitat.	5	7	GL	(AG, CCG)	Low- Moderate	Habitat is generally poor, but may be some utilization by Surprise Lake AG population. Subject to suspended sediment from placer operations.
	2	1.1	Confined, steep gradient. All high velocity riffle.	5	7	gL	(Ø)	Nil	Steep gradient - suspect no fish present.
	3	1.3	Moderately confined, moderate gradient. 90% riffle.	5	(5)	GL	Ø	Nil	Habitat marginal - suspect no fish present.
	4	0.7	Confined, steep gradient	4	7	gL	(Ø)	Nil	Steep gradient - suspect no fish present
	5	1.9	Open meadow area, fairly low gradient. Extensively altered by placer work.	4	(4)	GL	(Ø)	Nil	Suspect no fish present.
	6 Ts	1.6	Altered and channelized. Steep gradient.	4	8	L	(Ø)	Nil	Suspect no fish present.
Ruby C. (69-9900-390-070)	1	0.9	Fluvial fan area with distributaries. Extensive alterations in upper section. 85% riffle habitat.	7	3.1	gL	AG (CCG)	Moderate	Habitat is fair - significant numbers AG caught in samples. AG probably spawn in lower part of reach. Subject to high suspended sediment from placer operations.
	2	1.7	Confined, steep gradient. Extensive alterations and diversions form impassable barrier.	7	8	gL	(Ø)	Nil	Steep gradient - extensive alterations.
	3	1.4	Entrenched with bedrock banks, steep gradient. One small falls.	5	7	L	(Ø)	Nil	Suspect no fish present

Table 8., continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Relative Fisheries Value	Rationale and Comments
Ruby C. (69-9900-390-090)	4	4.1	Frequently confined, moderate gradient, 80% riffle.	5	3.0	gL	Ø	Nil	Habitat is fair, but no fish present.
	5 Ts	1.8	Headwater area, braided channel. 90% riffle.	8	2.6	gL	(Ø)	Nil	Suspect no fish present.
Union C. (69-9900-390-110)	1	0.9	Fluvial fan area. All high velocity riffle.	6	7	gL	CCG (AG)	Low-Moderate	No AG captured, but AG may spawn in lower end near mouth.
	2	1.8	Entrenched, very steep gradient with cascades and falls.	5	12	L	(Ø)	Nil	Too steep for fish.
	3	1.2	Confined, moderate gradient. Bedrock banks. 50% pool/glide habitat.	5	4	gL	(Ø)	Nil	AG habitat fair, but suspect no fish present.
	4	1.6	Moderately confined, fairly low gradient, meandering. Some beaver dams. 60% pool/glide.	5	1.5	GL	Ø	Nil	AG habitat good, but no fish present.
	5	2.0	Small, shallow lakes.	-	-	-	(Ø)	Nil	Suspect no fish present - appear too shallow for over-wintering.
	6 Ts	0.5	Very small, low gradient, meandering.	1	2.9	Gl	(Ø)	Nil	Suspect no fish present.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Relative Fisheries Value	Rationale and Comments
Quartz C. (69-9900-390-130)	1	0.5	Fluvial fan area, fairly steep gradient. 90% high velocity riffle.	5	(13)	gL	(AG, CCG)	Low-Moderate	Habitat is poor, but AG from Surprise Lk. may spawn near mouth.
	2	2.6	Entrenched, steep gradient, cascade habitat.	5	11	L	(Ø)	Nil	Too steep for fish utilization.
	3 Ts	3.6	Confined, moderate gradient. 80% shallow riffle habitat.	5	4	gL	(Ø)	Nil	Suspect no fish present.
Moose C. (69-9900-390-150)	1	0.5	Fluvial fan area, fairly steep gradient. 100% riffle.	5	(13)	gL	(AG, CCG)	Low-Moderate	Habitat is poor, but AG from Surprise Lk. may spawn near mouth.
	2	3.0	Entrenched, steep gradient with impassable falls.	6	14	L	(Ø)	Nil	Too steep for fish utilization.
	3 Ts	3.6	Frequently confined, moderate gradient. 100% riffle.	10	1.7	gL	(Ø)	Nil	Suspect no fish present.
Horse C. (69-9900-390-190)	1	0.7	Fluvial fan area, steep gradient. 100% riffle.	6	(17)	L	(AG, CCG)	Low-Moderate	Habitat is poor, but AG from Surprise Lk. may spawn near mouth.
	2 Ts	2.5	Confined, very steep gradient, cascade habitat	3	12	L	(Ø)	Nil	Too steep for fish utilization.

Table 8', continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Relative Fisheries Value	Rationale and Comments
Cracker C. (69-9900-390-210)	1	0.9	Fluvial fan area, fairly steep gradient. 90% riffle habitat.	7	(8)	gL	AG (CCG)	Low-Moderate	Limited AG habitat near mouth - AG probably spawn in lower end of reach.
	2	1.7	Entrenched, steep gradient some cascades. 95% riffle.	6	7	L	(Ø)	Low	Probably too steep for fish utilization.
	3	1.0	Confined, steep gradient 90% high velocity riffle	5	6	L	(Ø)	Nil	Marginal habitat - suspect no fish present.
	4 Ts	1.7	Small, moderate gradient, mainly riffle.	2	4	gL	(Ø)	Nil	Suspect no fish present.
Unnamed C. (69-9900-390-210-020)	1	2.3	Confined, steep gradient 90% riffle.	5	9	L	(Ø)	Nil	Suspect no fish present.
	2 Ts	0.5	Small headwater area.	3	16	gL	(Ø)	Nil	Suspect no fish present.
Cup C. (69-9900-390-230)	1	0.8	Fluvial fan area. 60% riffle.	5	7	GL	(sp)	Low-Moderate	Habitat marginal, but lower portion may be utilized by Surprise Lk. species.
	2	3.2	Confined, steep gradient, cascade habitat.	5	8	L	(Ø)	Nil	Too steep for fish utilization.
	3 Ts	2.4	Moderately confined, headwater area. 100% shallow riffle.	5	8	gL	(Ø)	Nil	Suspect no fish present.

Table B1, continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Relative Fisheries Value	Rationale and Comments
Fourth of July C. (69-9900-410)	1	0.9	Frequently confined, moderate gradient. 80% riffle.	8	(3.2)	gL	AG, CCG, LSU (WF, BB)	Moderate	Habitat is fair, lower sections may be used for spawning and/or rearing of lake populations.
	2	1.3	Low gradient, meandering section. Mainly pool/ glide habitat.	8	0.5	fG	AG, CCG, LSU (WF, BB)	Moderate	Habitat appears good - may be utilized by lake populations.
	3	0.7	Confined, moderate gradient. 80% broken riffle habitat.	7	1.8	gL	AG, CCG, LSU (WF, BB)	Low-Moderate	Habitat is marginal, but AG and other species present.
	4	2.9	Moderately confined, fairly low gradient. 60% riffle habitat.	7	0.9	fGL	AG, CCG, LSU (WF, BB)	Moderate	Habitat is fair.
	5	2.7	Entrenched canyon area with impassible falls	7	4	L	(AG, CCG)	Low	All steep gradient riffle and cascade.
	6	3.3	Mainly low gradient, little confinement, 70% pool/glide.	8	(2)	GL	AG(CCG)	Moderate-High	Habitat appears good for both adult and juvenile AG. May be utilized for spawning by McDonald Lk. populations.
	7	0.5	Very small shallow lake	-	-	-	AG(CCG LT)	Moderate-High	AG and possibly LT present.
	8	0.8	Short flowing section between small lakes. Mainly bouldery riffle.	10	0.4	GL	AG(CCG LT)	Moderate-High	Probably spawning and rearing area for lake populations.
	9	1.4	Lower McDonald Lake	-	-	-	AG LT (CCG)	High	Good populations of AG and some LT appear to be present.
	10	0.7	Short, low gradient reach between lakes.	10	0.4	fG	AG (CCG, LT)	High	Probable spawning and rearing area for lake populations.
	11	2.5	McDonald Lake	-	-	-	AG, LT (CCG)	High	Good population of AG and some LT appear to be present.
	12	3.3	Low gradient, little confinement. 80% pool/ glide	5	0.7	FG	AG (CCG, LT)	High	Good habitat for adult and juvenile AG - probably used for spawning by lake populations.
	13	1.3	Confined, moderate gradient. 80% riffle.	4	1.2	GL	AG (CCG, LT)	Low-Moderate	Habitat fair.

Table 3. Continued.

Stream Name (Watershed Code)	Reach No.	Reach Length (km)	Reach Description	Chan. Width (m)	Approx. Slope (%)	Sub-strate	Fish Species Present (or suspected)	Relative Fisheries Value	Rationale and Comments
Fourth of July C. (69-9900-410)	14	0.7	Low gradient, meandering extensive beaver dams. 70% pool/glide.	4	0.4	fG	AG, LT (CCG)	Moderate-High	Fairly good AG habitat for both adults and juveniles - LT also present.
	15	8.7	Very low gradient, beaver dams throughout. Many large ponded areas.	10	0.3	L	AG, CCG	Moderate - High	Habitat appears poor for adult AG, but excellent for juveniles. Extremely large numbers of sub-adults captured in fish samples. Fish passage may be difficult due to beaver dams.
	16	0.7	Small, shallow lake.	-	-	-	(AG, CCG)	Moderate - High	Lake appears quite shallow, but large AG population below lake may indicate overwintering is possible.
	17	1.5	Small, very low gradient, extensive beaver dams.	2	1.0	L	(AG, CCG)	Low-Moderate	Habitat appears limited due to small size.
Two John C. (69-9900-410-030)	1	1.2	Small, mainly low gradient, some beaver dams.	2	(2.5)	FGL	(AG, CCG)	Low	Habitat appears limited.
	2	2.4	Confined, fairly steep. 60% riffle.	3	7	gL	(SP)	Low	Habitat is marginal - probably too steep.
	3	1.5	Entrenched, steep gradient. 90% shallow riffle.	4	8	L	(Ø)	Nil	Too steep for fish utilization.
	4 Ts	1.0	Small, moderately confined, moderate gradient	2	(6)	GL	(Ø)	Nil	Small headwater area - suspect no fish.
Volcanic C. (69-9900-410-110)	1	0.8	Fluvial fan area, fairly steep gradient.	5	(8)	gL	(AG, CCG)	Low	Habitat is generally poor, only extreme lower end of the reach may be utilized.
	2	1.1	Confined, steep gradient All shallow riffle.	7	18	gL	(Ø)	Nil	Steep - no fish present.
	3	1.9	Frequently confined, moderate gradient. Mainly broad, shallow riffle.	7	(8)	gL	(Ø)	Nil	Suspect no fish present.

APPENDIX C

Grayling age-length data for
Stewart River and Atlin study areas

TABLE C1: Mean fork length and standard deviation for Arctic grayling age classes from Stewart River and Atlin study areas.

	Fork Length	Age 0	1	2	3	4	5	6	7	8	9
Stewart River	Mean (mm)	55.6	120.1	139.9	173.8	205.6	241.0	285.0	270.0	343.8	372.0
	SD	9.8	18.4	17.5	20.8	19.4	16.3	29.7	-	40.6	82.0
	n	9	11	13	16	11	6	2	1	4	2
Atlin	Mean (mm)			137.2	188.0	208.8	300.0	310.0			320.0
	SD			13.6	13.0	7.5	19.0	-			-
	n			12	3	4	7	1			1

APPENDIX D

Examples of field data cards

REACH

Reach No. ____

System Name ____

No. ____

Survey Date ____ Compiling Agency ____ Field Obs. ____

yr mo day

Access ____ Weather ____

Field Photo Init. ____ Photo Nos. ____

Photo Interp. Init. ____ NTS Sheets ____

Air Photo ____ Yr. ____ Scale 1: ____

C	ACTIVE VALLEY WALL PROC.	Nil	L	M	H
	Avalanche				
	Debris flow/torrent				
	Slump				
	Slide				
	Gully				
	Periglacial				

TOTAL POOLS (%)	
Bedrock control (%)	

BED MATERIAL (%)	
Fines clay silt sand	
Gravel (2-64 mm)	
Large (64 mm+)	
Bedrock	

BAR PRESENCE	Nil	L	M	H
Side / Point				
Mid Channel				
Transverse				
Junction				
Diamond / Braiding				
Lee				
Dense				
Islands				

LATERAL CHANNEL MOVEMENT	Yes	No
Apparently Stable		

	Nil	L	M	H
Bar Veg. Progressions				
Cut-Offs / Or. Bows				
Meander Scars				

	Yes	No	
Anabranches			
Terraces			
Constrictions			
Unstable Banks (%)			

CHANNEL COVER	Level	% Area	Distr.
Crown			
Overhang			

RIPARIAN VEG.	Storey	Sp	Distr.
Coniferous			
Deciduous			
Understorey			
Ground			

CHAN. WIDTH (m)						
Stage	Dry	L	M	H	Fld	
Flow Char.	P	S	R	B	T	
Valley:Chan	0-2	2-5	5-10	10+	N/A	
Confinement	Exr	Conf	Pr	Oc	Un	N/A
Pattern	St	Sin	Ir	Im	Ra	Tn
Vert. Stab.	Deg	?	Agr	N/A		
Side Chan	Nil	L	M	H		

FISH SUMMARY	C	Species	Use	Ref	Map

STREAM FEATURE	F	Type Code	Ht (m)	Length (m)

	Nil	L	M	H
Channel Debris				
Floodplain Debris				

Stable Debris (%)				
Turbidity	Nil	L	M	H

(Fish)

(Width) (Vall: Chan) (Slope) (Bed Material)

FIGURE D1. Reach data card.

POINT / HABITAT CARD

Card ____ of ____

System Name ____ Point No. ____ Reach No. ____

Watershed No. ____ Date ____ Time ____

Site Location ____ Weather ____

Access ____ Agency ____ Crew ____ NTSmap ____ Air photo no. ____

Field Photo Init ____ Fish Sample: yes ☐ no ☐

Habitats Sampled ____ Water temp(°C) ____ Turbidity(cm) ____ Stage ____

Habitat Type/No.	
Length(m)	
Wetted Width(m)	
Channel Width(m)	
Max. Depth (cm)	
Av. Depth (cm)	
Velocity (m/sec)	
Slope (%)	Cover (%)
Cover Components (%)	
Compaction L M H	
Flow Char. P S R B T	
Fines	Cobble
S. Gravel	Boulder
L. Gravel	Bedrock

Habitat Type/No.	
Length(m)	
Wetted Width(m)	
Channel Width(m)	
Max. Depth (cm)	
Av. Depth (cm)	
Velocity (m/sec)	
Slope (%)	Cover (%)
Cover Components (%)	
Compaction L M H	
Flow Char. P S R B T	
Fines	Cobble
S. Gravel	Boulder
L. Gravel	Bedrock

Habitat Type/No.	
Length(m)	
Wetted Width(m)	
Channel Width(m)	
Max. Depth (cm)	
Av. Depth (cm)	
Velocity (m/sec)	
Slope (%)	Cover (%)
Cover Components (%)	
Compaction L M H	
Flow Char. P S R B T	
Fines	Cobble
S. Gravel	Boulder
L. Gravel	Bedrock

FIGURE D2. Modified point data card.

FISH SAMPLE

Fish Sample No. _____
Card _____ of _____

System Name _____
No. _____
Site Location _____
_____ Point No. _____
Sample Date _____ Time _____ Reach No. _____
yr mo day
NTS Map _____ Access _____ Weather _____
Field Photo Init. _____ Photo Nos. _____
Agency _____ Crew _____

WATER QUALITY	C	Turbidity		C	Horiz. Visibility	
			m cm			m

Total No.	Species	Method	Size (cm) Min	Size (cm) Max	Fish Use	Sampling Length (m)	Sampling Time $(s,m,h)_T$	Sampling # Sets	Diff.

C / Cx	COMMENTS

FS 3 88

INDIVIDUAL FISH DATA

Fish No.	Species	Sampling Method	Sex	Maturity	Fork Length (cm)	Weight (gm)	Age	Sample Type & No(s)

FIGURE D3. Fish data card.

APPENDIX E

Examples of computer reports for
reach, point, and fish data

REACH FILE DATA ENTRY - VISUAL EDIT REPORT

REACH RECORD

REACH NO. 0005.00

SYSTEM NAME(OR ALIAS) MINTO C
SYSTEM NO..... 62 $850 060 000 000 000 000
SURVEY DATE(YYMMDD).. 820703 AGENCY..... YUK FIELD OBS. IP
ACCESS..... U WEATHER.... CLOUDY
FIELD PHOTOS..... YES
PHOTO INTERP INIT.... IP NTS SHEETS. 115P9
AIR PHOTO(S)..... A19604:30

LENGTH(KM)..... 5.8 TYPE R
DIST. UP STREAM(KM)..... 20.4
SLOPE(%)..... 0.5
ELEVATION(M)..... 689
LATITUDE/LONGITUDE..... 634100/1360801
YEAR/SCALE..... 6671: 50000

ACTIVE VALLEY WALL PROCESS
AVALANCHES..... N
DEBR FLO/TORRENT N
SLUMPS/GLIDES... N
SLIDES..... N
GULLY..... M L
PERIGLACIAL..... N

BAR PRESENCE
SIDE/POINT..... N
MID CHANNEL..... N
TRANSVERSE..... N
JUNCTION..... N
DIAMOND/BRAIDING.... N
ICE..... N
DUNES..... N
ISLANDS..... N

02 TOTAL POOLS (%)..... 40
BEDROCK CONTROL (%)..... 0
BED MATERIAL (%)
FINES (CLAY SILT SAND) 80
GRAVEL (2-64 MM)..... 20
LARGE (64 MM+)..... T
BEDROCK..... 0

CHANNEL COVER
LEVEL % AREA DIS
CROWN..... 0 0
OVERHANG..... 5 A

RIPARIAN VEGETATION
STORY SP DIS
CONIFEROUS.....
DECIDUOUS.....
UNDERSTOREY.....
GROUND.....

LATERAL CHANNEL MOVEMENT
01 APPARENTLY STABLE..... N
BAR VEG. PROGRESSIONS... N 04
CUTOFFS/OX BOWS..... L 05
MEANDER SCARS..... L
AVULSIONS..... N
TERRACES..... N
CONSTRICTIONS..... N
UNSTABLE BANKS (%)..... 20

03 CHANNEL WIDTH (M)..... 6

STAGE..... M
FLOW CHAR..... P
VALLEY CHAN..... 10
CONFINEMENT..... OC
PATTERN..... IR
VERT STAB..... 2
SIDE CHAN..... L

CHANNEL DEBRIS..... L
FLOODPLAIN DEBRIS.. L
% STABLE DEBRIS.... 50

TURBIDITY..... 0

FISH SUMMARY

	SPECIES	USE	REF	MAP
	AG	R	YUK	
06	(BB)		FMS	
	CCG	R	YUK	
	(LSU)		FMS	
06	(NP)		FMS	
06	(at)		FMS	

STREAM FEATURE

DIST. UPSTREAM	TYPE	HEIGHT	LENGTH	LATITUDE	LONGITUDE
15.4	P 2			634319	1360458
16.1	BV		3900	634316	1360547
19.5	PM		500	634206	1360745
20.0	OPBV		3900	634153	1360754
20.0	OPPM		500	634153	1360754

C 01 CHANNELS MAY BE ALTERED REGULARLY BY BEAVER DAMS.
C 02 APPROXIMATELY 40% POOL (MAINLY FORMED BY BEAVER DAMS), 60% GLIDE. VIRTUALLY ALL LOW VELOCITY POOL/GLIDE HABITAT. THERE ARE SEVERAL SMALL LAKES ATTACHED TO THE CHANNEL.
C 03 MUCH WIDER IN PLACES WHICH ARE DAMMED BY BEAVERS.
C 04 APPROXIMATELY 70% PLACID, 30% SWIRLING.
C 05 MORE CONFINED (5-10 OR 2-5) IN PLACES.
C 06 THESE SPECIES CAPTURED BY FISHERIES & OCEANS (UNPUBLISHED) IN MINTO LK. ARE PROBABLY PRESENT IN THE UPPER PART OF THE REACH.

F 01 BV , - THERE IS A ZONE OF BEAVER DAMS PRESENT.

G THERE IS A PLACER OPERATION IN THE BENCHLAND ON THE LEFT VALLEY WALL JUST BELOW MINTO LAKE. CHANNEL ALTERATION IS NOT EXTENSIVE.

APR 08, 1983 AQUATICS INVENTORY SYSTEM - POINT SAMPLE AND FEATURE LISTING SUMMARY PAGE 58

SYSTEM NUMBER 62 3850 060 000 000 000 000 SYSTEM NAME MINTO C NUMBER OF REACHES 4

MAXIMUM ELEVATION (M) 1597 MAINSTEM AZIMUTH (DEG) 281 NUMBER OF LAKES 1

OUTLET ELEVATION (M) 567 LENGTH LONG AXIS (KM) 24 NUMBER OF POINTS 2

AREA (KM2) 333 MAINSTEM LENGTH (KM) 24.6 SURVEY YEAR 82

PERIMETER (KM) 97.2 EXTENT MAINSTEM SURVEYED (KM) 10.8 MAP SCALE 1/ 10000

NTS MAP SHEETS 105H12 115P09

KM FROM START OF SURVEY	C	FEATURE	LENGTH (M)	HEIGHT (M)	ELEV. (M)	LATITUDE	LONGITUDE
		OUTLET					
0.0		REACH 1.00 (R)			567		
8.3		POINT SAMPLE = 1					
10.6		REACH BREAK 1.00	10600		658	63 42 56	135 58 10
						63 43 16	136 00 15
10.6		REACH 2.00 (R)					
12.9		TRIBUTARY WITH INFO				63 43 21	136 02 28
14.6		TRIBUTARY WITH INFO				63 43 13	136 04 10
14.6		REACH BREAK 2.00	4000		674	63 43 13	136 04 10
14.6		REACH 3.00 (R)					
15.4		POINT SAMPLE = 2					
16.1		BEAVER DAM	3900			63 43 19	136 04 58
19.5		PLACER MINING OPERATION	500			63 43 16	136 05 47
20.0		UPPER ZONAL BOUNDARY - BV	3900			63 42 06	136 07 43
						63 41 53	136 07 54
20.0		UPPER ZONAL BOUNDARY - PM	500				
20.4		REACH BREAK 3.00	5400		689	63 41 53	136 07 54
						63 41 44	136 08 01
20.4		REACH 4.00 (LAKE)					
24.3		TRIBUTARY WITH INFO				63 41 03	136 11 49
24.6		TRIBUTARY WITH INFO				63 41 06	136 12 07
24.6		REACH BREAK 4.00	4200		689	63 41 06	136 12 07

APR 08, 1983 AQUATICS INVENTORY SYSTEM - FISH SPECIES DISTRIBUTION

SYSTEM NO: 62 3450 060 000 000 000 000 SYSTEM NAME (OR ALIAS): MINTO C

NO. OF REACHES: 4 MAINSTEM LENGTH (KM): 24.6 MAX. ELEV. (M): 1547

NO. OF LAKES: 1 AREA (SQ. KM): 333 OUTLET ELEV. (M): 567

NO. OF UNIQUE POINTS: 2 PERIMETER:

FISH DISTRIBUTION BY REACH

REACH	DISTANCE UPSTREAM (KM)&	COMMENT NUMBER	SPECIES *	USE +	REFERENCE
1.00	10.6		GRAYLING (ARCTIC)	R	YUKON
			(BURBOT)		FISHERIES AND MARINE SERVICE
			SLIMY SCULPIN	R	YUKON
			(LONGNOSE SUCKER)		FISHERIES AND MARINE SERVICE
		06	(FISH OBSERVED)		FISHERIES AND MARINE SERVICE
2.00	14.6		GRAYLING (ARCTIC)	R	YUKON
		07	(BURBOT)		FISHERIES AND MARINE SERVICE
			SLIMY SCULPIN	R	YUKON
		07	(LONGNOSE SUCKER)		FISHERIES AND MARINE SERVICE
3.00	20.4		GRAYLING (ARCTIC)	R	YUKON
		06	(BURBOT)		FISHERIES AND MARINE SERVICE
			SLIMY SCULPIN	R	YUKON
			(LONGNOSE SUCKER)		FISHERIES AND MARINE SERVICE
		06	(NORTHERN PIKE)		FISHERIES AND MARINE SERVICE
		06	(WHITEFISH(GENERAL))		FISHERIES AND MARINE SERVICE
4.00	24.6		GRAYLING (ARCTIC)		YUKON
			BURBOT		FISHERIES AND MARINE SERVICE
			SLIMY SCULPIN		FISHERIES AND MARINE SERVICE
			(LONGNOSE SUCKER)		YUKON
			LAKE TROUT		YUKON
			LAKE WHITEFISH		FISHERIES AND MARINE SERVICE
			NORTHERN PIKE		FISHERIES AND MARINE SERVICE

* ( ):INFERRED

+ R:REARING
M:MIGRATION
S:SPAWNING

& IF 'Z' REACH, DISTANCE UPSTREAM IS RELATIVE TO START OF SIDE CHANNEL

APR 08, 1983 AQUATICS INVENTORY SYSTEM - AGGREGATE FISH SUMMARY REPORT

SYSTEM NAME (FOR RELEASE) ARMIJO C

SYSTEM NUMBER: 62 3850 000 000 000 000 000

SUMMARY OF
FISH SPECIES (KNOWN OR INFERRED)

SPECIES	DISTRIBUTION (KM)
BURBOT	0.0 - 24.6
FISH OBSERVED	0.0 - 10.6
GRAYLING (ARCTIC)	0.0 - 24.6
LAKE TROUT	20.4 - 24.6
LAKE WHITEFISH	20.4 - 24.6
LONGNOSE SUCKER	0.0 - 24.6
NORTHERN PIKE	14.6 - 24.6
SLIMY SCULPIN	0.0 - 24.6
WHITEFISH(GENERAL)	14.6 - 20.4

APPENDIX F

Selected climatological data for
Stewart River and Atlin study areas

MAYO, YUKON Lat 63 37' N Long 135 52' W Elevation 495 m - Mayo lies in the broad valley of the Stewart River surrounded by relatively high mountains. Strong radiation results in rapid heating and cooling. The extreme maximum of 36.1 is the highest temperature recorded in the Yukon. Mayo's extreme minimum of -62.2 is exceeded only by Snags North American official record of -62.8 which occured at the same time.

1959-1978 calc. TEMPERATURES	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
Mean Daily Max.	-24.2	-12.3	-4.1	5.9	13.9	20.3	22.0	19.3	12.4	2.0	-12.1	-18.3	2.1
Mean Daily Min.	-34.9	-25.1	-19.0	-6.8	0.6	6.4	8.0	5.6	0.7	-6.5	-21.8	-28.7	-10.1
Mean Daily	-29.6	-18.7	-11.6	-0.4	7.3	13.4	15.0	12.5	6.6	-2.3	-16.9	-23.5	-4.0
Extreme Max.	10.0	12.2	12.2	22.8	31.7	36.1	33.9	31.0	26.7	18.3	13.9	11.9	36.1
Year/Date	30/35	27/68	26/30	29/76	28/47	14/69	11/65	5/77	2/38	7/64	2/70	6/34	
Number of Years of Record	54	54	54	55	55	55	55	54	55	53	54	54	
Extreme Min.	-58.3	-62.2	-48.9	-41.1	-21.7	-3.3	-2.8	-8.9	-15.6	-36.9	-50.6	57.8	-62.2
Date/Year	28/47	3/47	5/51	1/44	11/64	26/51	23/28	31/41	28/46	27/35	26/50	13/46	
Number of Years on Record	56	55	55	55	55	54	55	54	55	53	54	55	
PRECIPITATION													
Mean Rainfall	TR	TR	TR	1.7	17.6	40.0	53.1	43.0	29.6	5.8	0.6	TR	191.4
Mean Snowfall	20.6	20.1	12.0	8.6	2.7	NIL	NIL	TR	3.1	22.9	27.9	26.5	144.4
Mean Total Pcpn.	19.0	17.9	10.9	9.7	20.3	40.0	53.1	43.0	32.7	28.7	25.9	23.9	325.1
Number of Days of Msrbl Pcpn.	9	8	6	6	8	11	13	12	11	10	10	11	115
Mean Month End Depth of Snow on Ground	38	37	36	2	NIL	NIL	NIL	NIL	NIL	9	25	35	
Max. Pcpn.	99.6	36.3	39.4	44.7	44.8	79.8	107.7	100.3	69.3	67.3	52.6	66.8	
Year	43	32	30	26	76	65	79	73	70	58	56	31	
Min. Pcpn.	TR	TR	TR	TR	6.4	6.9	9.9	4.8	1.5	3.8	TR	2.0	
Year	40	36	SVRL	SVRL	46	26	40	33	58	48	40	32	

ATLIN, BRITISH COLUMBIA Lat 59 34' N Long 133 42' W Elevation 701 m - Atlin is located on the east shore of Atlin Lake and is typical of stations having the rain shadow effect to the lee of the Coast Mountains. Atlin Lake due to its size does not freeze over till late December or January. The resultant fog and stratus retards the occurrence of severe winter temperatures. Climatological data dates back to 1906 but there is a break in the records from 1946 to 1967.

1959-1978 calc. TEMPERATURES	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
Mean Daily Max.	-14.3	-6.9	-2.6	4.5	10.5	15.4	17.5	16.7	12.4	5.5	-3.5	-7.7	4.0
Mean Daily Min.	-22.3	-16.5	-13.4	-4.8	-0.2	4.3	6.6	6.4	3.0	-1.1	-9.6	-14.2	-5.2
Mean Daily	-18.3	-11.7	-8.0	-0.2	5.2	9.9	12.1	11.6	7.7	2.2	-6.6	-10.9	-0.6
Extreme Max.	7.2	10.6	10.0	17.5	26.7	30.6	30.0	29.4	26.7	18.9	13.3	9.4	30.6
Year/Date	11/26	27/68	/10	28/79	26/36	14/69	31/76	20/77	2/38	/35	3/26	15/44	
Number of Years of Record	54	54	53	54	52	53	52	53	54	52	52	52	
Extreme Min.	-47.8	-47.2	-39.4	-31.1	-8.9	-3.9	-1.1	-2.2	-11.1	-26.7	-33.3	-50.0	-50.0
Date/Year	31/25	3/68	1/19	2/20	1/72	/11	3/37	/10	24/72	/35	/09	25/17	
Number of Years on Record	54	54	53	54	52	53	52	53	54	52	52	53	
PRECIPITATION													
Mean Rainfall	0.7	1.2	0.4	2.0	11.6	22.5	27.9	32.8	29.7	25.1	5.8	3.2	162.9
Mean Snowfall	33.4	21.7	16.2	6.8	1.2	TR	NIL	NIL	0.8	13.0	25.8	23.1	142.0
Mean Total Pcpn.	34.1	22.9	16.6	8.8	12.8	22.5	27.9	32.8	30.5	38.1	31.6	26.3	304.9
Number of Days of Msrbl Pcpn.	9	6	5	4	5	5	9	9	9	10	9	9	39
Mean Month End Depth of Snow on Ground	22	29	12	TR	0	0	0	0	0	TR	5	12	
Max. Pcpn.	95.3	55.4	53.8	30.2	27.2	67.1	95.3	82.6	89.4	101.9	93.2	78.7	
Year	34	07	09	14	42	42	30	69	63	44	17	13	
Min. Pcpn.	5.3	0	0	0	0	2.3	0	0	3.3	11.7	1.0	1.0	
Year	46	45	06 43	11	44	43	44	45	26	16	21	45	